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Second Session: Dunedin, February 3 to 10, 1927

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SECTION IV.—PATHOLOGY AND BACTERIOLOGY.

ASCENDING RENAL INFECTION.

By C. H. KELLAWAY, M.C., M.D., M.S., M.R.C.P. (London); C. J. O. BROWN, M.D. (Melbourne), F.R.C.S. (England)
AND
F. ELEANOR WILLIAMS.
(From the Walter and Eliza Hall Institute, Melbourne.)

(Continued from page 192.)

The work of two more recent observers whose experiments favour ascent along the lumen, is also not wholly free from objection on the ground of insufficient control of the possibility of blood infection. Brewer (1911) injected organisms into the bladders of dogs and produced artificial retention for twenty-four hours which was then relieved. The animals killed after various intervals were found to have gross pyonephrosis. Injury to the kidney was found to favour hæmatogenous rather than ascending infection. David (1918) who also used dogs for his experiments, found that when coliform organisms were introduced into the bladder in animals in which one ureter had been ligated and divided, the pelvis of the kidney whose ureter was unobstructed, became infected, while the hydronephrotic kidney and the blood cultures taken at autopsy were sterile. In animals in which in addition the urethra had been partially obstructed and which were killed one to five days after the operation and infection of the bladder, the urine in the pelvis of the unobstructed kidney was infected in ten out of eleven experiments. As will be shown in the present paper, neither failure to grow bacteria from the blood taken at autopsy nor a sterile hydronephrosis can be relied upon to exclude blood infection, though the latter control appears to be efficient for the earlier hours of the experiment.

Experimental Work.

Our experiments have been carried out upon guinea pigs, rabbits and cats in which partial obstruction of the urethra or disorganization of the nervous mechanism of micturition had been produced. In many of them we occluded one ureter either by simple ligation or by division between two ligatures. Only in guinea pigs were micro-organisms introduced into the bladder. These were coliform bacilli, streptococci, diphtheroids and staphylococci which were pathogenic for the animal in question and which were obtained by injecting one cubic centimetre of a broth emulsion of fresh guinea pig fæces into the bladder of a female guinea pig in which the urethra was then partially obstructed. In our other experiments we used in place of microorganisms suspensions of "oil-blue." All operations were performed under full ether anæsthesia and with aseptic precautions.

Like most other workers we experienced great difficulty in infecting the healthy bladders of normal animals. The operative procedures which were employed to produce interference with normal micturition, were not by themselves followed by any infective lesion in the urinary tract, but if organisms in pure culture were introduced into the bladders of these animals, a superadded infection readily occurred.

In our first series of fifteen experiments partial obstruction of the urethra was produced in guinea pigs of five hundred to six hundred grammes weight by passing round the urethra a short piece of split rubber catheter which when tied in position had an internal diameter of 3·5 millimetres. In this way a sufficient grade of obstruction was produced to cause definite distension of the bladder, though the obstruction could be overcome by pressure on the abdominal wall. In addition the right ureter was ligated close to its entry into the bladder.

In three experiments an emulsion of *Staphylococcus albus,* in five of streptococci, in five of diphtheroids and in two of a Gram-negative bacillus was introduced into the bladder. In most cases the animals were killed after two to four days. The autopsy was carried out aseptically. Cultures were taken from the heart and bladder, of the cortex of the kidneys after cauterization of the surface and of the urine obtained from the pelves of the kidneys by puncture after deep cauterization of the kidney substance or by direct puncture of the pelvis after the unligated ureter had been tied lest urine should be sucked up from the bladder.

In only three of these experiments was the pelvis of the unobstructed kidney sterile at autopsy and in all but two of the rest the bacterial flora was identical with that found in the bladder. This coincidence of the flora in the bladder and unobstructed pelvis has been a very common finding in our experiments, though there are many exceptions. It may be explained by successive or simul-

taneous blood infections which have all ceased to be demonstrable at autopsy or more simply by ascent from the bladder along the lumen of the unobstructed ureter or its lymphatics. If this latter explanation be correct, the exceptions which are easily explained by the blood-borne theory, must either be regarded as cases in which the secondary infection in the bladder has been later acquired and in which these organisms have not had time to ascend, or accounted for alternatively by assuming that both organisms have reached the pelvis, but owing to the descending flow of urine or to the inability of some bacteria to cause pelvic infection, only one has become established.

In four of these experiments organisms were isolated from the blood without there being any corresponding infection in the urine from the pelvis of the obstructed kidney and in two other cases organisms were isolated from the obstructed kidney, but the blood cultures taken at autopsy were sterile. It was, therefore, apparent that neither the failure to grow organisms from the blood at autopsy nor the sterility of the kidney from which the outflow has been obstructed by ligation of the ureter, could be relied upon to exclude blood infection.

In three experiments in which organisms were obtained from blood cultures, the ureter had been tied for eleven to twenty-one days before the bladder was infected and the greatly diminished blood supply to these hydronephrotic kidneys may have accounted for their failure to become infected. We investigated this point further and found that when one ureter was tied with or without urethral obstruction and organisms were injected intravenously, the obstructed kidney was not invariably infected. Twenty-four hours after the operation of ligation of the right ureter when the affected kidney was in a state of passive congestion resulting from obstruction of the venous return by the pressure of the dilated pelvis, the tied off kidney was infected in four out of five experiments. When the injection was made two, three or four days after the operation, the kidney did not become infected. These experiments further emphasize the fact that blood cultures taken at autopsy cannot be relied upon to detect bacteriæmia during life, as in only two cases were organisms recovered from such blood cultures.

In our next series of experiments we denervated the bladder by destroying the nerve roots in the spinal canal below the level of the iliac crests. A uniform functional impairment of the bladder resulted which was unaccompanied by any paralysis of the hind limbs, though occasionally a slight and transitory ataxia was noted soon after the operation. If the animal were not interfered with, the bladder became distended, though any very slight pressure on the abdominal wall or such contraction of the abdominal muscles as occurred if the animal moved briskly caused forcible expulsion of urine. One ureter was ligated immediately before the spinal operation and organisms were introduced into the bladder before the animal recovered from the effects of the anæsthetic.

Of six experiments in which diphtheroids were injected into the bladder, in four the pelvis on the unobstructed side contained the organism at autopsy, in three of them in pure culture, though streptococci were also present in the bladder in all but two. In four experiments with staphylococci and streptococci no organisms were found. In all cases the blood cultures and those from the pelves of the kidneys with tied ureters were sterile. The results in these, as in the experiments in which the urethra was obstructed, may be equally well explained by blood or lymphatic infection or by spread along the lumen of the ureter and afford no clear indication as to which course the organisms pursued.

The observations of a number of workers who have injected bacteria into the blood stream of normal animals, indicate that several hours elapse before the organisms appear in the urine. We injected an emulsion of diphtheroids into the jugular veins of guinea pigs in which the urethra had been partially obstructed or in which the sacral nerve roots had been destroyed, and found that at least six hours were required before diphtheroids could be grown from the bladder urine. A series of six guinea pigs in whom the urethra was partially obstructed, received intravenously 0·25 cubic centimetre of a thick emulsion of diphtheroids. These were killed three, four, five and six hours after the injection. In all diphtheroids were recovered from the heart blood at autopsy and in all but the two animals killed six hours after the injection the urine obtained from the bladder by cautery and puncture was sterile. Another group of eight animals whose sacral nerve roots were destroyed, was similarly treated and killed two, three, four, five, six and seven hours after the injection. In all these the blood at autopsy contained diphtheroids, though in none of them were the organisms recovered from the urine.

When organisms are introduced into the bladder, the pelvis of the unobstructed kidney becomes affected too early for this result to be explained by blood infection. Among ten guinea pigs in which the sacral nerve roots were destroyed, the right ureter ligated through the flank and the bladder infected with diphtheroids, the urine in the pelvis of the left kidney was found to contain diphtheroids in one animal killed two hours, in one three hours, in two four hours, in two five hours and in one six hours after injection. In all of these the urine from the pelvis of the right kidney and the heart blood were sterile and diphtheroids were recovered from the bladder and from the right ureter below the ligature. The three remaining animals were killed, two immediately and one an hour after the injection. In these the urine from both kidneys and the heart blood were sterile, diphtheroids being recovered from the bladder only.

Another group of ten animals in which the urethra was partially obstructed and in eight of

which the right ureter was ligated, gave similar results. Of four killed after four hours, diphtheroids were recovered from the urine in the pelvis of the left kidney of three. In two killed after three hours and in one killed after two hours the urine of the left pelvis contained diphtheroids, while of three killed after one hour the left pelvis of two was sterile. The presence of an abdominal wound in close proximity to the orifice of the urethra from which infected urine was leaking, made it more difficult to avoid blood infection which occurred in three of the four-hour and in one one-hour guinea pig. The urine from the right kidney was sterile in all animals whose corresponding ureter was tied, and in one animal only had ascent on the unobstructed side failed to occur after the second hour.

Under the conditions of our experiments localization in the pelvis of the unobstructed kidney occurs regularly within two hours. The possibility that during the manipulations involved in chloroforming the animals bacteria might be forced by pressure up to the pelvis or that the force of the injection might cause ascent up the lumen of the ureter is excluded by the negative findings in animals examined immediately and one hour after the injection. Ascent after death is excluded by our unvarying practice of tying the ureters at autopsy before puncturing the pelvis and further by our inability in nearly all cases to cause dyes to pass up the ureters by applying large pressures within the bladder. The regularity with which we achieved these results with diphtheroids when contrasted with the irregularity of ascent by other organisms, as seen in the longer experiments reported earlier in this paper, suggests that in this animal diphtheroids more readily establish themselves on the surface of the pelvic mucosa.

Our second group of experiments were carried out with suspensions of easily recognizable solid particles or of pigments insoluble in water. The animals investigated were the guinea pig, rabbit and cat. After the sacral nerve roots had been destroyed or before the urethra was obstructed and while the animal was still under the anæsthetic, these sterile suspensions were injected into the bladder with full aseptic precautions. At varying periods after these procedures the animals were killed and their kidneys were removed after double ligation of the ureters and division between the ligatures. The urine was withdrawn from the pelvis with a Pasteur pipette and the kidney was subsequently laid open and the mucosa lightly scraped. The pelvis urine and the scrapings were examined for the presence of the substance which had been introduced into the bladder. In some experiments we fixed the ureter in "Formalin," dehydrated, cleared and mounted it before examining it for particles and in other cases serial sections of the ureter and pelvis were cut and examined.

In guinea pigs our results wholly paralleled our experience with diphtheroids. In five experiments in which the urethra was partially obstructed and a suspension of carmine introduced into the bladder, particles of carmine were invariably present in the pelvis of one or both kidneys after from two to three and a half hours. In two experiments with lycopodium suspended in saline solution with the aid of a trace of bile salt, the particles were present in the pelvic urine when the animals were killed after twenty-four hours.

In guinea pigs in which the sacral nerve roots had been destroyed, ascent of the particles of pigment was not so regular, but occurred in four out of eight experiments in which the animals were killed from two to four hours after the injection of carmine.

In our experiments with rabbits and cats we used carmine and lampblack suspensions, together and separately. In two cats with obstruction of the urethra there was no ascent of carmine after twenty-four and fifty hours respectively and in two similar experiments with rabbits there was no ascent in forty-three and forty-six hours. After the sacral nerve roots had been destroyed we also obtained negative results with carmine after forty-eight hours in both cats and rabbits (two experiments). When, however, we used a mixed suspension of lampblack and carmine we found black particles regularly in the pelvic urine, though the carmine had failed to ascend. This was the case forty hours after the injection in three experiments, in a cat with sacral roots destroyed and in a cat and a rabbit with urethral obstruction.

It occurred to us that the carbon particles might more readily ascend than carmine on account of their lightness and, since the use of lampblack was objectionable on account of the presence of pigment particles in the preparations from the pelves of many of our cats and rabbits, we sought to find other distinctive particles which would remain suspended instead of separating out by gravity as does carmine. An emulsion in water of olive oil in which "oil-blue" was dissolved gave excellent results in a number of experiments and blue particles were invariably present in the pelvic urine in cats and rabbits with obstruction or after special operations as early as twenty hours after injection into the bladder. However, the particles were solid masses and not oil globules stained blue and furthermore we were able to demonstrate that similar blue particles were constantly present in the pelvic urine of kidneys whose ureters had been tied before the injection and must have been excreted by the kidney from the blood in these cases.

We finally decided upon lycopodium suspensions in saline solution as being the most suitable, a trace of bile salt being used to lower the surface tension sufficiently to permit of their being wet by the liquid. Of six experiments five yielded wholly negative results, but in one rabbit four hours after obstruction of the urethra a particle of lycopodium was found in the pelvic urine of one kidney.

In the other experiments four were in rabbits twenty-four and forty-eight hours after urethral obstruction or destruction of the sacral roots and one in a cat twenty-four hours after urethral ob-

struction. One other useful type of experiment remains to be mentioned. In two young cats we destroyed the sacral nerve roots and kept the animals alive and in good condition for six weeks, daily expressing the urine from their bladders. We then injected carmine and left them, one for twenty-four and the other for forty-eight hours. In the latter case a single carmine particle was found in the pelvis of one kidney.

It is clear that in cats and rabbits the conditions upon which ascent along the lumen depend, are very different from those which obtain in the guinea pig. In the last-named animal ascent very readily takes place if the mechanism of normal micturition is disorganized. The animal micturates several times in the day, whereas the cat and the rabbit only do so about once in twenty-four hours, so that the effects of obstruction or interference with micturition are felt in the guinea pig much earlier than in the other two animals. It should also be noted that the search for particles is much more inconclusive than the recovery of living organisms by culture, only one or two microorganisms may ascend, yet, as in the case of diphtheroids, their ascent is regularly demonstrable under the conditions of our experiments. The finding of a single particle in one among a number of negative experiments is significant if transport by the blood can be excluded. As regards the lymphatics our experiments with carmine are strongly opposed to the view that ascent in guinea pigs can be explained in this way as the particles were invariably found within the lumen of the ureter and pelvis and never in the wall of the ureter or its accompanying lymphatics.

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PROFESSOR J. B. CLELAND (Adelaide) asked whether bedsores accompanying kidney infection might not be due to spinal lesions when the bladder was infected. He had noticed this in Adelaide. There was no inflammatory reaction round the bedsores and no tendency to thrombosis in the veins. Hence there was a continued passage of bacteria into the blood stream from the bedsores. These organisms were filtered through the kidney and in consequence pyonephrosis might occur. There were many other conditions in which organisms in the blood stream might be excreted through the kidney and so cause infection.

DR. J. F. MACKEDDIE (Melbourne) said that it was interesting to physicians to know how the bacteria got into the circulation as far as renal infection was concerned. Infection by the blood was more prompt than by the lymphatics or the ureter. From the infection of the bladder an endocarditis might occur without infection of the kidney. The physicians' work was based on the pathological investigation. He was interested in the different rate at which different organisms reached the pelvis of the kidney.

DR. KELLAWAY replied that he would emphasize one or two points in his paper. In reply to Dr. MacKeddie and Professor Cleland it was clear that the general trend of evidence from his experiments was that ascending infection was possible along the lumen under the two types of conditions described. This was not the only method of ascent, for unquestionably there was ascent along the lymphatics. There was, however, no evidence of direct infection of the urine through the lymphatics without first an infection of the blood stream.

With regard to Professor Cleland's remarks on bedsores he thought that it was extremely probable that bedsores might occur in this way. They could quite readily be a source of blood infection. When organisms were introduced into the bladder, ascent might readily occur along the lumen of the ureter. The establishment of infection in the urinary tract after ascent depended on the nature of the organism. Infection from the blood stream might also depend on the same factor. He had never seen experimentally produced a definite extensive lesion of the kidney resembling the type known as surgical kidney. Infection of the pelvis of the kidney was all that was produced. He did not deny the possibility of lymphatic infection, but there was no clear evidence that it occurred. He would not state dogmatically that the lumen was the only path of infection.

SOME CONSIDERATIONS ON THE ANÆMIAS, LEUCHÆMIAS, LEUCOSARCOMA AND ALLIED CONDITIONS.

By L. B. BULL, D.V.Sc.,
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AND
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WE make no attempt in the following notes to treat with the subject of the anæmias, leuchæmias, leucosarcoma and allied conditions fully or in a formal manner. We desire to place before you certain random observations which may be of some interest and which may lead to discussion.

Pernicious Anæmia.

We have conducted numerous blood examinations on hospital patients and those of private practitioners over a period of fourteen years without anything evolving which might reasonably be expected to throw light on the ætiology of the disease. Nor have we anything to add which has not already been said many times by others. With regard to laboratory diagnosis, we have found that a high colour index with megalocytosis is almost absolutely diagnostic. We place more importance on the presence of megalocytosis of the red cells than on the high colour index. The degree of megalocytosis is arrived at by direct observation always under the same magnification. These observations are made directly in the counting chamber as well as in the stained film. The blood is not regarded as megalocytic unless over 30% of the red cells have a diameter larger than normal. We do not spend time in hunting for nucleated red cells, for we place little reliance on the differentiation of the type of nucleated red cell as of diagnostic importance. We regard a leucopenia as of great assistance in arriving at a diagnosis, but it may sometimes be absent although always present at some stage of the disease. We rely on the type of red cell present in the blood, the megalocyte. A high colour index may be obtained in conditions other than pernicious anæmia, but never with the characteristic megalocytic red cell. Megalocytes may occur in other conditions, but they usually do not reach more than from 1% to 5% of the red cells.

In those cases which have come under observation, the disease has been progressive in the great majority, although the hæmoglobin and red cell count usually fluctuate. Remissions may occur, but they are infrequent in our experience. One case of short remission is of interest:

A woman of about fifty-five years of age was sent for a blood examination by a private practitioner. The typical picture of pernicious anæmia was found. This diagnosis was confirmed by the practitioner and the patient informed accordingly. About twelve months later the patient when staying with friends developed bronchitis and another medical man was called in. The patient informed the practitioner that her condition had been diagnosed as a case of pernicious anæmia. As she still doubted the correctness of this diagnosis, she asked this second practitioner for an opinion which he refused to give before having a report on the condition of the blood. The patient presented herself at the laboratory in a few days' time for the blood examination making no mention of the previous examination. The examination revealed a slight anæmia of the secondary type, there being nothing present to suggest a pernicious anæmia. Fortunately, the patient was recognized at the laboratory and it was suggested to the practitioner that a guarded opinion was indicated. The patient died a few months later from pernicious anæmia. This case illustrates the fact that during a remission the blood may lose all characteristics of the disease.

It is claimed that carcinoma of the stomach may at times give rise to an anæmia which is difficult to differentiate from a pernicious anæmia. In view of this it is interesting to note that a patient admitted to the Adelaide Hospital under the care of Dr. Ray in 1923 showed a typical blood picture of pernicious anæmia and at autopsy nine months later a carcinoma of the stomach was found. Under treatment the hæmoglobin value of the blood increased from 33% to 80% in three months. On account of this and for other reasons we regard the case as one of pernicious anæmia with independent gastric carcinoma. A more complete record of the case can be found in the *Medical and Scientific Archives of the Adelaide Hospital*, No. 4, 1925.

The association of achlorhydria with pernicious anæmia is now well recognized. There are a few cases on record, however, in which free hydrochloric acid was found in the gastric contents. It is only of recent years that attention has been directed to the gastric secretion in pernicious anæmia and during this time only one case has come under our notice in which free hydrochloric acid was present in the gastric contents.

The Pernicious or Hæmolytic Anæmia of Pregnancy.

Several cases of severe secondary anæmia during or immediately following pregnancy have come under our notice, but only one case of that special form of hæmolytic anæmia which is sometimes found occurring during the latter months of pregnancy and the *post partum* state.

This patient was a woman, *ætatis* twenty-five years, admitted under the care of Dr. F. S. Hone to the Adelaide Hospital in 1924. Four months before admission, when she was eight months pregnant, she became weak and run down and had diarrhœa. This state continued until she was delivered of a healthy child. She rested in bed for ten days and improved, but when she got up and began to work again, the symptoms returned and increased in severity. Diarrhœa became more frequent and she was troubled by a dry cough. Small ulcers appeared in her mouth. She lost a great deal of weight and her skin became sallow and yellowish. Her temperature on admission was 37·8° C. (100° F.), the pulse rate 120, systolic blood pressure 96 and diastolic 56 millimetres of mercury and respirations 24 to the minute. She was a thin woman with a muddy, yellow complexion, the exposed parts of her skin being pigmented. On the front and lateral aspects of her legs were small, subcutaneous hæmorrhages, about six on each leg. Examination of her blood three days after admission revealed hæmoglobin 50%, red cells 2,250,000 per cubic millimetre, colour index 1 and white cells 6,800 per cubic millimetre. The red cells showed anisocytosis, poikilocytosis and polychromatophilia. The urine contained lactose and urobilin. Five days later the hæmoglobin had fallen to 40%. The red cells showed poikilocytosis, anisocytosis and some megalocytosis. Her skin was becoming more yellow and less muddy in colour, but the hæmoglobin value of the blood fell steadily. There was free hydrochloric acid in the gastric contents. She received benefit from a transfusion of 650 cubic centimetres of blood. A summary of the blood examinations is given in Table I. Although a high colour index was exhibited almost throughout, there was an absence of that degree of megalocytosis which is characteristic of pernicious anæmia.

Table I.

Date.	Hæmoglobin %.	Red Cells.	Colour Index.	White Cells.
May 17 ..	50	2,250,000	1	6,800
May 22 ..	40	1,500,000	1·2	9,300
May 26 ..	22[1]	1,340,000	0·73	5,400
May 29 ..	[2]			
May 30 ..	50	2,000,000	1·1	5,000
June 3 ..	45	2,150,000	0·94	6,500
June 10 ..	50	2,140,000	1·1	
June 13 ..	40	1,830,000	1·1	
June 17 ..	30	1,264,000	1·05	
June 24 ..	27	1,200,000	0·84	
June 29 ..	[2]			
June 30 ..	50	2,230,000	1	
July 5 ..	31	2,310,000	0·6	
July 12 ..	12	785,000	0·69	3,800

[1] There is probably an error in this examination.
[2] Transfusion of 650 cubic centimetres of blood.

Towards the end she vomited every evening. There was continued oozing of blood from the right nostril and general emaciation. She passed several ounces of bright blood by the bowel. She got weaker and numerous small petechial spots appeared on her abdomen and neck just before she died, nine weeks after admission.

At the autopsy the liver was seen to be dark in colour with a brownish tint and did not give a macroscopic reaction for hæmosiderin. The spleen was somewhat enlarged, firm and dark red. The kidneys were somewhat pale. The retroperitoneal lymphatic glands along the aorta were vascular. Around the epiglottis, uvula, lower part of the pharynx and whole length of the œsophagus was an ulcerated condition, partly hæmorrhagic and discoloured greenish, partly with little raised white, necrotic areas. The œsophageal ulceration ceased abruptly at the stomach with the termination of the squamous epithelium. The base of the tongue showed slightly serpiginous, slightly raised areas surrounded by vascular rings. In the last thirty centimetres of the ileum were a number of transverse ulcers. The caecum and colon showed no lesions. The bone marrow in the femur showed a red reaction accompanied with a grey-like appearance. Microscopic section of the red lymphatic glands showed numerous vascular channels in the lymphoid tissue, with much endothelial proliferation and blood pigment granules in many of the endothelial cells. In the mucosa of the ileum there was a tendency to the formation of small areas of coagulation necrosis. There was a diffuse infiltration with fibrin and red cells and the epithelium had necrosed off. Microscopically hæmosiderin was found in the liver cells. A more complete record of this case is to be found in the *Medical and Scientific Archives of the Adelaide Hospital*, No. 4, 1925.

This hæmolytic anæmia of pregnancy although similar to pernicious anæmia appears to be distinct. Only the one case has come under our notice and not many have been recorded in the literature. The most recent observations are those of Osler (*The British Medical Journal*, January 4, 1919) and Rowland (*The Journal of the American Medical Association*, February 2, 1924).

Aplastic Anæmia.

There have been several patients in the Adeladie Hospital of recent years with severe anæmias of the aplastic type. Of these some have recovered after treatment, of which transfusion was the most beneficial, the response often being rapid and great with a flooding of the blood stream with nucleated red cells. One patient who failed to respond to transfusion and other treatment, was found to have generalized tuberculosis.

These anæmias were probably all of toxic origin. Unfortunately the cause of the condition has not been found in many of them as requests for permission to make an autopsy have been refused. None of the cases, however, can be regarded as primary aplastic anæmia and it does not seem possible to indicate the prognosis until the response to two or more transfusions has been observed.

Leuchæmia.

The leuchæmias are full of interest and anomalous cases are continually turning up. It is by studying such that we shall probably gain eventually the clearest insight into the ætiology of this group of diseases. Lymphatic leuchæmia is distinct from the myeloid form, being derived from cells of lymphoid origin. Myeloid leuchæmia is derived from cells of the granular series in the bone marrow. Sometimes these cells when very immature (myeloblasts) may resemble closely those of lymphatic leuchæmia. It is possible that the cell found in the blood in cases of so-called acute lymphatic leuchæmia without enlargement of the lymphatic glands has its origin in the bone marrow and is distinct from the cell of lymphatic and that of myeloid leuchæmia. We do not intend to deal with myeloid leuchæmia and shall confine our remarks to some observations on lymphatic leuchæmia.

One of the points we have to consider is whether leuchæmia, that is a decided increase of the white cells of the blood, is the essential and primary lesion of the disease or merely a secondary result and not necessarily an inevitable one. Thus in the early stage of lymphatic leuchæmia it is possible that for a long time a pathological condition might be present in the glands without any overflow of lymphocyte-like cells into the blood stream. The following seem to be illustrative cases:

A patient was admitted to the Adelaide Hospital with enlargement of the lymphatic glands of the neck and other situations. On examination of his blood he was found to have a typical picture of pernicious anæmia with high colour index, megalocytosis of the red cells and a leucopenia. He was treated for some time, but his condition showed little or no alteration. About nine months later another blood examination was made when a picture of lymphatic leuchæmia was discovered, although the red cells were still megalocytic and the colour index high. Such a condition is usually described as leuchanæmia, but the delay in the development of a high white count, although the lymphatic glands were enlarged for many months, is interesting.

Recently Dr. C. T. C. de Crespigny showed us blood films taken from a patient with a mediastinal tumour. Films were examined from time to time over a period of months before the picture of a lymphatic leuchæmia became apparent.

J.L., a male, *ætatis* sixty-eight years, was admitted to the Adelaide Hospital complaining that he had collapsed on a hot day a fortnight before and had been in bed since. Twelve years before he first noticed lumps in his neck. These gradually got bigger, but were never tender or painful. Two years before admission he noticed lumps in his axillæ and groins and at this time he began to feel ill, becoming weaker and losing weight. On admission, examination of his blood revealed hæmoglobin 54%, red cells 2,520,000 per cubic millimetre and white cells 256,000 per cubic millimetre. Mononuclear cells of the lymphocyte group comprised 98% of the white cells present. In this case the lymphatic glands were probably enlarged for some years before the lymphocytes became increased in numbers in the blood stream. This case is fully recorded in *Medical and Scientific Archives of the Adelaide Hospital*, No. 4, 1925.

G.W., a male, *ætatis* sixty-six years, was admitted to the Adelaide Hospital with enlargement of the lymphatic glands at the right elbow and in the axilla, right and left side of the neck and inguinal regions. He first noticed a painless lump near the right elbow six months previously when he also had a sore on the dorsum of the right hand. His blood had been examined about six weeks before admission when no increase in the white cells was found. The day after admission his blood showed hæmoglobin 41%, red cells 3,304,000 per cubic millimetre, white cells 422,000 per cubic millimetre. The white cells consisted almost entirely of large lymphocytes. He died three days after admission. The enlargement of the lymph glands existed for six months, yet there was no definite increase in white cells in the blood until just before death. This case is recorded more fully in THE MEDICAL JOURNAL OF AUSTRALIA, February 18, 1922.

In this connexion one is struck with the fact that in normal circumstances cells such as the lympho-

cytes are restrained from entering the blood stream in undue numbers. There is abundant lymphoid tissue in the body. This is stuffed with multitudes of lymphocytes. It cannot surely be a difficult thing for these to pass into the lymphatic stream and so get into the blood stream, yet such an overflow does not normally occur and even in those ordinary diseases where a lymphocytosis occurs, the excess with the exception of lymphatic leuchæmia is small. We see the same in the bone marrow in myeloid leuchæmia. Red cell-forming areas are present as well as myelocyte-forming areas, yet there is no excess of red cells in the circulation. Evidently some restraining mechanism exists normally governing the number of cells of different kinds that are present in the circulating blood. The mechanism is probably similar to that which restrains the size of the liver, the kidney or the testis. These organs do not grow indefinitely in size. Nevertheless, if the left lobe of the liver or one kidney or one testis be destroyed, the other lobe or the other organ will nearly double in size. In the leuchæmias we evidently have this barrier done away with or overcome. Is it overcome by extreme multiplication of cells behind it together with change perhaps in the characteristics of these cells? This is probably the explanation in the cases of lymphatic leuchæmia just mentioned.

There are three views we may take as to the nature of leuchæmia and for the sake of simplicity we propose to consider here lymphatic leuchæmia. The disease may be (i.) a hyperplasia of lymphoid tissue with eventually an overflow of cells into the circulation, the result of a dyscrasia, that is of some imperfection in development or of some tendency to revert to an earlier type, affecting the cells engaged in manufacturing lymphocytes. Under this view one would expect lymphoid tissues in general, including those of the intestines, to show this weakness.

The following case which has been published in the *Medical and Scientific Archives of the Adelaide Hospital*, No. 5, 1925, showed enlarged glands and such an increase in size of the lymphoid tissue of Peyer's patches that these formed polypoid projections.

J.T., a man of sixty-three, had had some small lumps in the right side of his neck for many years. A year before admission these had begun to enlarge. He had enlarged glands in many situations. One excised from the groin showed some lymphatic hyperplasia. Mitotic figures were present. The blood count showed 20,000 white cells per cubic millimetre. The autopsy showed enlarged glands in many situations including the mediastinum and in the abdominal cavity around the aorta and extending to the mesenteric, coronary, pyloric and other lymphatic glands. The spleen was not enlarged. The lymphoid patches throughout the whole of the small intestine especially in the terminal portion of the ileum had hypertrophied forming polypoid projections into the lumen. A similar large patch seven and a half centimetres in diameter was found in the caecum.

(ii.) It may be a hyperplasia of lymphoid tissue with overflow due to the stimulant action of some toxin or the establishment of a virus. If due to a toxin the lesions might tend to be focal, if the toxin was produced in one particular part of the body as for instance the intestines or the reaction might be general if the toxin soon entered the blood stream. The case just cited of J.T. might be equally well explained by the action of a toxin as by a pure dyscrasia. The same applies to a virus. Some viruses may remain localized perhaps for long, whereas others may become universally seeded in receptive tissues at an early stage. The case of G.W. already mentioned might suggest the entrance of a virus through a sore on the hand with enlargement of the draining lymphatic glands before generalization.

(iii.) The leuchæmias have been likened to malignant neoplasms and it has been suggested that they actually do represent such arising in lymphatic tissues or from certain constituents of the bone marrow and spleen. We know, however, a malignant-like condition, lymphosarcoma, whose behaviour is quite unlike lymphatic leuchæmia. Lymphosarcoma commences in one area from which it extends to adjacent parts first. This is a characteristic feature of malignant growths. They are nearly always single and they spread from a centre, cells being transported by the lymph stream or blood stream and establishing themselves elsewhere. In the leuchæmias it does not seem that the disease commences in one centre from which other parts are seeded. In ordinary lymphatic leuchæmia we find various organs and tissues stuffed with the lymphocyte-like cells. Collections of these form in various parts so that under the microscope considerable accumulations are visible. It is probable that there is actual local multiplication in some of these areas as a general rule. Collections of such cells may be met with in the subcutaneous tissues. In the case of G.W. already mentioned incisions made for removing a gland for examination became extensively infiltrated with proliferating cells, presenting a malignant appearance. Our interpretation was that cells had been caught in the granulation tissue and had found this a favourable nidus for extensive multiplication.

Chloroma is a leuchæmic disease with greenish, tumour-like masses sometimes plastered on the skull. We have had no examples ourselves. We have, however, had two remarkable cases which we consider come under the title of leucosarcoma, that is there is present both an actual or potential leuchæmia and tumour-like infiltrating masses composed of the same type of cell. What is this condition? Is it merely an exaggeration of the original disease where local multiplication of arrested cells has proceeded to an extreme degree or does it represent the development of a true malignant condition as the result of continued insults to the multiplying lymphoid cells? In our cases the infiltration tends to be confined to or to be more extensive in certain situations as might be expected of a malignant growth. The tumour-like masses also present a solid, opaque, whitish appearance again characteristic of malignant masses. We have noticed, however, that microscopically the infiltration by these lymphocyte-like cells is more diffuse and extensive than is usually the case with invading malignant cells. In the kidney, for instance, we may find throughout a section here and there remains

of tubules and glomeruli whereas in an ordinary malignant invasion it is usually only round the edge of the mass that these remnants of the original structure are found.

A.C.B., a male, *ætatis* thirty-eight years, was admitted to the Adelaide Hospital on January 8, 1923, complaining of pains in the legs. There was some loss of power in one leg and other nerve lesions. On January 24 he was much weaker and dyspnœic and died on January 26 with his temperature elevated. The white cells numbered 11,000 per cubic millimetre. The red blood cells were reduced in number with a low colour index and the presence of megaloblasts and a few normoblasts. Many of the leucocytes were immature and embryonic and 80% of them were members of the lymphocyte group. The picture was considered that of an anæmia associated with profound marrow change probably from aberrant functioning and in the laboratory report it was suggested that the condition might be classed as a leuchæmia. The *post mortem* examination (No. 10/23) showed a plaque-like mass composed of infiltrating lymphocyte-like cells pressing on the *cauda equina*, thus explaining the nervous symptoms. On the ribs were some diffuse, whitish elevations due to the same type of cell. There were a few small plaques in the epicardium and some small ones in the liver. The cortex of both kidneys was studded with numerous whitish nodules, sometimes with central spots of hæmorrhage and with outlines more ill-defined and with an infiltration more diffuse than is usually seen in secondary malignant deposits. There was an extensive malignant-looking mass of infiltration adherent to the bladder and surrounding the prostate and adjacent parts. Full details of the case will be published in the *Medical and Scientific Archives of the Adelaide Hospital* for the year 1926.

A second case of a leucosarcoma occurred in a man, T.A., *ætatis* fifty years at the time of its development. He was under observation for some time before an enlarged spleen was detected, having been admitted for paraplegia following compression under a wagon. A laminectomy was performed. The lower part of the spinal cord had apparently been nipped at the time of the accident and had undergone atrophy, so that the patient never recovered from the paraplegia. His general health at this time seemed good. Following an unexpected and transient rise of temperature after the patient had been seven months in hospital, it was found that he had a spleen well below the costal margin. Later a blood examination showed an increase of leucocytes of from 36,000 to 48,000 with a great predominance of lymphocytes. The patient's health still remained unaffected. He stated that he had had an enlarged mass in his splenic region for eleven years and that it gave him no trouble and had apparently not increased in size. The patient went to a nursing home in October, 1925, and was readmitted *in extremis* on April 28, 1926. The *post mortem* examination (No.82/26) revealed numerous enlarged, somewhat soft, pinkish lymphatic glands in the neck, axillæ and groins. Very extensive, neoplastic-looking infiltration of the tissues round the aorta extended outwards into the perirenal tissue on each side forming cuirasses around each kidney and invaded the kidney tissue on each side from the hilum and pelvis and thence extended outwards into each cortex. The kidneys lay as in a mould imbedded in the infiltrated perirenal tissues. The pancreas was infiltrated. The scrotal sac on one side showed infiltration and there was a mass of glands adherent to the lower part of the trachea, but otherwise no infiltration of the thorax. This case will be described in full in the *Medical and Scientific Archives of the Adelaide Hospital* for the year 1926.

Another patient whose condition illustrated the fact that lymphatic leuchæmia may be a terminal event, was sent to the laboratory for a blood examination by Dr. A. A. Lendon when the only definite abnormality found was a leucopenia, the white cells being 4,200 per cubic millimetre, while the hæmoglobin was 94%.

The patient, a woman, *ætatis* twenty-nine years, was suffering from vague ill-health. Four years later she became anæmic, developed a rash in the skin and the lymphatic glands of the neck began to enlarge. The blood picture was that of a leuchæmia. The glands enlarged rapidly and the patient became worse, dying within two or three months. It seems possible that the leucopenia discovered four years before the death of the patient was an expression of the disease process which eventually led to her death.

We are coming to believe that the leuchæmic picture, that is a high content of more or less immature white cells in the blood, is only incidental to the disease and not the essential characteristic. From the point of view of diagnosis and prognosis it is important to recognize at least that the leuchæmic picture may only manifest itself as a terminal event.

There are many forms of hyperplastic enlargement of the lymph glands. Whether all these are liable to terminate with a leuchæmic picture if the disease is not treated and checked we do not know nor do we know whether the ætiology is the same for the disease which manifests itself as a leuchæmia from the beginning as for that type which shows only a terminal leuchæmia.

DR. ETHYL BYRNE (Newcastle) said that Professor Cleland had referred to blood transfusion in a case of aplastic anæmia. She had seen six patients with this condition, only one of whom had transfusion. This patient died and at the *post mortem* examination thrombosis of the cavernous sinus was found. She thought that this might have been caused by the transfusion.

DR. P. P. LYNCH (Dunedin) said that he was interested in Professor Cleland's reference to the case in which there were lymphoid cells in the tumour round the kidney. He had had a similar case in Wellington. The kidney was thought to be tuberculous and was removed at operation. On section lymphoid cells were found throughout the organ with a few remnants of kidney tissue remaining. The case was further investigated, but the patient had not suffered from lymphatic leuchæmia. The patient died later of uræmia. He described another case of a young woman with tumour masses in both breasts. The tumour was composed of small round cells. There were enlarged glands in other parts of the body and the case was rapidly fatal.

DR. A. B. PEARSON (Christchurch) said that in the routine examination of anæmic patients in the Christchurch Hospital he found a constant achylia in pernicious anæmia. This was also found in subacute combined degeneration, but in aplastic anæmia he found no achylia. Smears and cultures of test meals were regularly made in the Christchurch Hospital. In achylia bacteria were always found throughout the meal not only in anæmias, but also in achylia associated with other conditions, for example, rheumatoid arthritis. The types were nearly always streptococci and staphylococci. The types were those found in the mouth and upper air passages. In cases where there was subsequently discovered a carcinoma, there was a greater growth of flora than in pernicious anæmia and organisms such as *Micrococcus catarrhalis* were common. Obviously the hydrochloric acid was the strong antiseptic, as the smallest concentration inhibited the growth of organisms. Careful examinations were always made of the meals before they were given in order that they could be certain that the meals were sterile. In some cases it was found that there was some infection present. Should the patient have a good acid curve even the organism present in the meal before administration was inhibited. Other experiments were carried out with the use of bile as an inhibiting agent, but it was found that the organisms grew unless the bile was present in high concentration.

In the treatment of conditions similar to pernicious anæmia vaccines were often asked for. It was customary to make these vaccines from test meals thus enabling a pure culture to be obtained rapidly. He was not in favour of using vaccine in these cases, but advocated the administration of frequent doses of hydrochloric acid to inhibit the growth of organisms.

DR. A. H. TEBBUTT (Sydney) said that he had examined test meals for the presence of bacteria. He found that in the presence of hydrochloric acid only small numbers of bacteria were obtained on culture. In the absence of free hydrochloric acid large numbers of bacteria were found. He had found organisms similar to those found by Dr. Pearson, but he had also obtained large Gram-negative cocci. In pernicious anæmia he had noticed that when there was an atypical blood picture, the clinical signs and symptoms were also atypical.

Professor Cleland's paper on the leuchæmias was very interesting especially his description of infection from a wound. He had seen a similar condition in Sydney. A student had received a wound in a dissecting room and subsequently noticed an enlarged gland at the elbow. Symptoms resembling diaphragmatic pleurisy had been observed and there had been hæmorrhages into the skin over the whole body. There had been no leucocytosis and the leucocyte count had varied from 4,000 to 7,000. There had been a progressive fall in the polymorphonuclear-neutrophile cells and other granular cells. There had been a rise in monocytes. These cells had a varying morphology of the nucleus, but they were non-granular. The patient had died in thirty-five days. At the *post mortem* examination all organs were found to be packed with the same kind of cells as those found in the blood. He wondered did these cells enter the blood of the internal organ and leave it again before reaching the peripheral circulation. He mentioned Aschoff's work.

It had occurred to him that in aleuchæmic leuchæmias the condition might be really a leuchæmia of the reticulo-endothelial system. In the capillary vessels of the spleen and lymphatic glands there were cells of the reticulo-endothelial system. He thought these cells passed from the right side of the heart to the lungs and there left the blood vessels passing into the alveoli. They must have got into the marrow by the systemic circulation. But the feature of these cells was that they wandered from the blood stream. They were not essentially blood cells. They must have entered the peripheral circulation and left it again.

DR. J. F. MACKEDDIE (Melbourne) said that there was a great change of view with regard to blood conditions, especially in connexion with nomenclature and blood film pictures. When the cause of pernicious anæmia was really discovered, he thought there would be a change of name. With regard to the neurological findings in pernicious anæmia the modern view was that subacute combined degeneration was not a sequence of pernicious anæmia, but an accompanying manifestation. In Queen's Square it was regarded as entirely independent.

Professor Cleland had given a very clear statement with regard to the ætiology of lymphatic leuchæmia. There was a tendency to group all these conditions as some diabolical disturbance of all the blood-forming organs. That was why he was not surprised to find in pernicious anæmia an accompanying lymphatic condition and *vice versa*.

RENAL EFFICIENCY: WITH SPECIAL REFERENCE TO VARIOUS EFFICIENCY TESTS.

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PHYSICIANS and surgeons must agree concerning the impossibility of assessing renal function from a purely clinical examination and that laboratory investigation is necessary for accurate diagnosis and prognosis. Authorities are agreed that the mere examination of the urine for albumin, pus, casts and bacteria is insufficient, since it is well known that advanced renal disease or degeneration may be present without any evident changes in the urine.

Hence biochemists have evolved a number of tests during recent years which aim at a qualitative and to a lesser extent quantitative estimation of the renal function. Whooping cough is said to have 555 cures, with adherents to each specific and similarly there are many efficiency tests none of which is as yet by any means perfect, though each has its warm advocates. In this short paper I can hope to give only a general survey of this now massive subject and to touch on the more popular tests from the clinician's point of view.

The principal functions of the kidneys are the excretion of water, waste products of nitrogenous metabolism, acid products and toxins and the maintenance of the blood salts at a constant composition. In Cushny's theory of the secretion of urine the glomeruli are supposed to play the part of passive filters of the blood plasma, which subsequently is concentrated in its passage down the tubules; but in all probability the glomeruli possess a selective capacity of actively excreting waste products and salts. Urea is concentrated from the blood into the urine some eighty times, creatinin forty times and uric acid about thirty times and not equally, as would be the case according to Cushny.

To gauge the functioning of the kidneys there are four principal methods of investigation: (i) The chemical analysis of the blood, to observe any quantitative alteration of its composition, (ii) the analysis of the urine and its relationship to the blood analysis, (iii) the reaction of the kidneys when submitted to a strain of excreting a definite quantity of some substance given by the mouth, whereby its powers of concentration may be determined, (iv) the rate of elimination of certain dyes, such as indigo-carmine or phenolsulphonephthalein, when artificially introduced into the circulation.

The requirements in medical and in surgical cases differ somewhat and in consequence tests which gain the approval of the surgeon may differ from those approved of by the physician. No one test will give equally satisfactory information in all cases of inefficiency and accordingly, one must choose the test appropriate to the case.

Renal problems fall conveniently into three classes: the medical problem, the obstetric and the surgical.

The Medical Problem.

The medical problem is encountered in the insurance proponent, otherwise normal, who has albuminura. Maclean found albuminura in 5% of 60,000 healthy soldiers and presumed its existence to that extent in the whole adult population. He also proved by means of efficiency tests that their renal function was normal in the vast majority of cases. He considered that the condition was a normal variation of health and would not predispose to subsequent nephritis.

Again, in patients who have formerly suffered from acute nephritis, the continued presence of protein in the urine does not necessarily indicate active disease; tests disclose no deficiency of the kidneys; consequently it is safe to lighten up on their diet and routine.

In following the progress of a case of acute or subacute nephritis the physician can often foretell by watching the non-protein nitrogen curve, whether chronic nephritis will supervene or whether improvement will take place, even in the face of opposing clinical signs.

But it must be admitted that on the whole the efficiency tests are disappointing as regards medical affections of the kidney. The amount of nitrogen retention bears little relation to the extent of renal damage. It is said that two-thirds of the kidney substance must be out of commission before nitrogen retention takes place at all. The kidney's power of concentration is not usually being exerted at its maximum effort and unless this capacity for concentration is seriously damaged, nitrogen will not accumulate in the blood. Even in severe cases of impairment of concentrating power the lesion may be compensated by the excretion of large amounts of dilute urine, which keeps the amount of urea in the blood at a normal figure.

Nitrogen retention is best diagnosed by blood analysis; it gives the most information about medical affections of the kidney, though Maclean, perhaps somewhat biassed, asserts that his concentration test will show improvement in a patient recovering from nephritis before any change in the blood is evidenced.

It must not be forgotten that conditions other than renal disease will be associated with a high nitrogen content of blood; intestinal obstruction, an abdominal abscess or an empyema will mislead the unwary if the blood examination alone should be relied upon; in such case, a high urine-urea estimation in addition should put one on one's guard.

Further in cardiac disease associated with a mild degree of nephritis a high non-protein nitrogen figure is often obtained, being due to the cardiac condition alone; it clears up altogether with improvement of the heart.

Probably the most important part of treatment of nephritis is the provision of a correct diet; this can be done only by watching the renal efficiency. Until quite recent years either a low protein or salt-free diet or both were exhibited; but nowadays these routine restrictions may be modified. Certainly the more protein taken in food, the greater will be the amount of nitrogenous waste products formed, which have to be excreted by the kidneys. But investigation has shown that increase of protein food does not increase albuminuria nor the amount of protein in the blood, since in the process of digestion protein is broken down into amino acids, circulated in the blood as such and selected by the various tissues for resynthesis into their own required protein. Even though definite symptoms of renal impairment are present, efficiency tests may reveal no interference with the excretion of the nitrogenous waste products. Accordingly protein foods may be increased, often with great benefit to the patient and the progress of the disease.

The Obstetric Problem.

The obstetric problems are of three types: (i) Cases of albuminuria with no symptoms, (ii) cases of albuminuria with symptoms of headache, vomiting, œdema *et cetera,* (iii) cases of albuminuria with symptoms of eclampsia.

In the first group there is no evidence of renal insufficiency or nitrogen retention and these are probably cases of functional albuminuria. The condition will give no trouble, but should be carefully watched nevertheless and the patients should be kept on a low protein diet.

In the second group the efficiency tests are of very great value and importance, as they differentiate between old-standing chronic nephritis and pre-eclamptic conditions. In the former the non-protein nitrogen is raised and continues to rise as a pregnancy proceeds and the blood pressure is on the high side. In these cases it is often necessary to terminate pregnancy as the renal condition is always worse after delivery, especially if the pregnancy continues to full term.

In the preeclamptic condition the blood composition is normal and the blood pressure not high, though it rises if eclampsia supervenes.

In the third group if eclampsia is actually present, the blood urea and to a greater extent the non-protein nitrogen are high. It is impossible, however, to judge the imminence of eclampsia from pre-eclampsia by the efficiency tests.

The Surgical Problem.

The problem of the "surgical kidney" is twofold. Is the renal function good enough to withstand a severe operation, especially one connected with the genito-urinary system, such as prostatectomy? Secondly, when nephrectomy is contemplated, is the remaining kidney good enough to carry on the burden of life?

It is in these cases that the functional tests are so necessary, nay, imperative. Since their introduction the mortality of prostatectomy has fallen from 30% to 5% and that of nephrectomy from 40% to 2%. It is to be remembered that the amount of nitrogen retention bears little relationship to the extent of actual renal damage and that obstruction to the urinary flow produces much greater nitrogen retention than the most severe kidney lesion. But after relief of chronic urinary obstruction recovery of function can take place. This fact is made use of especially in connexion with prostatic lesions. A poor response to a functional test will demand that the operation be done in two stages; the second stage to await the pleasure of a more encouraging test result. The tests have also taught us that a preliminary cystotomy is more efficacious than draining the bladder by a self-retaining catheter.

In the now limited time at my disposal I propose to epitomize the merits and demerits of the better known tests.

First of all I shall consider the tests dependent on blood analysis. The most commonly used are the estimation of the blood urea and the non-protein nitrogen. The normal amount of both these is twenty to forty milligrammes per hundred cubic centimetres, being nearer twenty milligrammes in youth and nearer forty after the prime of life. But it has now been realized that these two do not always run

parallel and that the non-protein nitrogen estimation is the more sensitive index of the two and should be used in preference to the blood urea test. A low protein diet, however, will lower considerably both these readings, even in the presence of advanced disease and so the diet must always be taken into account.

Prostatectomy should be done in two stages if the non-protein nitrogen is sixty milligrammes or over and the blood urea is fifty milligrammes or over. The fact must not be lost sight of that the actual operation of prostatectomy adds about twenty milligrammes to the figures of urea and non-protein nitrogen and this increase may endanger the patient's life.

The following factors must also be taken into account as regards the value of these readings. Cardiac failure may cause an increase of non-protein nitrogen due to passive congestion. The presence of œdema may cause an increase due to reabsorption of urea from the fluid. The loss of fluid through sweating or diarrhœa may influence the result, as may the presence of acute febrile diseases, intestinal obstruction and large abscesses.

Uric acid is normally present in amounts of from two to three milligrammes per hundred cubic centimetres. In a recent paper in *The British Journal of Surgery* by Cohen, Dodds and Webb, they couple uric acid with non-protein nitrogen as the most reliable indices; 3·5 milligrammes in their opinion is a bar to one-stage prostatectomy. The presence of gout, of course, disposes of its value.

Many people, more especially of the Scottish schools, place great reliance on the creatinin estimation. At one time this was considered as reliable as a register; 1·5 milligrammes was normal, 3·0 milligrammes demanded the two-stage operation of prostatectomy, 4·0 milligrammes denoted the early onset of uræmia and 6·0 milligrammes heralded in death at any moment. The test lost caste when a reading of 2·5 milligrammes was occasionally accompanied by uræmia and 8·0 milligrammes was present in an otherwise healthy individual.

Recently de Wesselow has recommended the estimation of the blood phosphates as being highly reliable, being increased in azotæmic nephritis.

Of course, blood analysis does not give any information concerning a unilateral lesion, except in so far as the total efficiency is concerned.

The estimation of the blood urea by the urease method or of the non-protein nitrogen is too complicated and laborious for use by the general practitioner and accordingly a simple and accurate method of gauging the urea content of the blood, which can be done in a few minutes by the busy practitioner, should not be overlooked. It has been recognized that urea is easily diffusible and is approximately equally distributed in all the tissues and all the fluids of the body, including, of course, the cerebro-spinal fluid and saliva. Saliva has been found to be a very reliable and useful indicator of nitrogen retention, the combined urea and ammonia nitrogen of the saliva closely approximating that of the urea nitrogen of the blood. Though the combined urea and ammonia nitrogen of the saliva does not always reach the exact amount of the blood urea nitrogen, the relation of the concentration of the two fluids is very definite, so that the salivary estimation may be regarded as a valuable index of the renal functional capacity.

The technique is very simple and can be completed in five minutes. A 5% solution of mercuric chloride is placed in a burette and titrated into five cubic centimetres of saliva, a drop of saturated solution of sodium carbonate being used on a porcelain dish as an indicator. The end point is indicated by a reddish-brown tinge in the carbonate solution. It is found that in normal subjects twenty to fifty cubic centimetres of the mercuric chloride solution is required to combine with one hundred cubic centimetres of the saliva and that this corresponds to the normal twenty to forty milligrammes of blood urea. The values will not always agree absolutely, but will run parallel. This method I have found most reliable and one that is particularly useful when dealing with children or nervous people who object to needles being thrust into them. In a series of tests carried out at the Wellington Hospital in which I compared the blood urea and the salivary urea, I was amazed at their parallelism, as I admit that I commenced the investigation with considerable doubtings.

In connexion with analysis of the urine it is always wise to ascertain the amount of urea present for comparison with the blood urea.

Assessing diastase was at one time used for estimating the renal function, but this has proved entirely unreliable. The diastase content is influenced by hepatic and pancreatic derangement and the test has been given up in consequence.

Dealing now with tests dependent on the concentrating power of the kidneys, the simplest is the water test of Volhard. As you all probably know this means that the patient drinks one and a half litres of water on an empty stomach, retiring to bed and emptying his bladder every half hour. A healthy individual eliminates this amount in about three hours, showing a high diuretic curve and a low specific gravity. With renal impairment the amount may be eliminated in four hours, but the individual amounts are more uniform in quantity and there is not the same rapid rise of the diuretic curve. Œdema, sweating or diarrhœa militates against its use.

In the concentrating test of Volhard the patient is kept on a dry diet overnight and the urine subsequently collected every two hours. Normally the individual portions drop quickly in quantity and the specific gravity rises to about 1030. With impairment of concentrating power the quantity of the portions is more uniform and the specific gravity does not rise to a great extent.

A similar but more complicated investigation is the Mosenthal test meal.

Finally there is the famous urea concentration test of Maclean, in which the patient takes fifteen grammes of urea dissolved in one hundred cubic

centimetres of water on an empty bladder. The bladder is emptied after one hour and again in two hours and the specimens examined for urea. If either specimen contains 2% of urea, the concentration power is not impaired, but lessened percentage is in proportion to renal inefficiency. Urea is one of the most potent diuretics and occasionally a diuresis is produced; if the second specimen (the important one) is over one hundred and twenty cubic centimetres the test should be repeated. This test is also dependent on the rate of absorption of urea from the small bowel and so secondarily on the rate of emptying of the stomach. Though suffering from these disadvantages, most valuable information has been gained from its aid.

Lastly we come to the tests dependent on the elimination of dyes, of which the most popular is phenolsulphonephthalein. An ampoule of this substance is injected intramuscularly and a catheter or ureteric catheters collect the urine in two samples after one and two hours. By colorimetric calculations the amounts of the dye excreted can be determined. By the first hour 50% and by the second hour 70% of the drug should be eliminated. This test is particularly useful in determining a unilateral lesion and the efficiency of the other kidney and is the one most extensively used in surgical practice. Its great drawback is that if any blood is present, an accurate colorimetric reading is impossible.

In conclusion, I would like to emphasize that all these tests are merely the handmaidens of the physician to assist him, together with a full physical examination and clinical acumen, in a full assessment of his case and are not to be considered in any way akin to the miraculous findings of the Abrams's box.

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DR. R. H. BAXTER (Hanmer) said that he supported Dr. MacKeddie in his plea for better clinical examination and better correlation between the clinical examination and the laboratory finding. Many genito-urinary surgeons believed absolutely in the blood urea tests as indicative of the fitness of the patient for operation. In many cases, however, they were let down by these tests. Even Maclean's figures were open to doubt especially with regard to blood urea. Many kidneys which were affected to a great extent, yielded a blood urea figure of only fifteen milligrammes and this led the surgeon to operate with bad results later. The blood urea figures must be considered very carefully and he was doubtful of any blood urea if it was not under ten milligrammes, especially if there was any sign of kidney inefficiency.

DR. RHIND replied that everyone agreed that the laboratory tests were still in their infancy. No one claimed any strength upon any one test. He did not agree with Dr. Baxter's remarks.

DR. J. F. MACKEDDIE (Melbourne) said that in kidney conditions they did not think enough of ordinary examination. With regard to the water test—quantity and specific gravity taken at intervals—this like all other tests was being replaced by chemical tests.

PARAGONIMUS RINGERI IN A NEW GUINEA NATIVE.

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In September, 1926, Dr. T. Clive Backhouse in charge of the laboratory of the Commonwealth Department of Health, Rabaul, New Britain, Mandated Territory of New Guinea, sent to this Institute some specimens which he had obtained from the lung of a native *post mortem*. Of the two flukes found which were identified by Dr. Backhouse as *Paragonimus*, he sent one whole and from the other which he had dissected, sent some eggs mounted on a slide.

This extremely interesting find is being reported and commented on elsewhere. These notes are concerned only with the specific determination.

The complete specimen was sent in 3% formalin solution and was in a well preserved but contracted condition. It was a thick fluke of regular

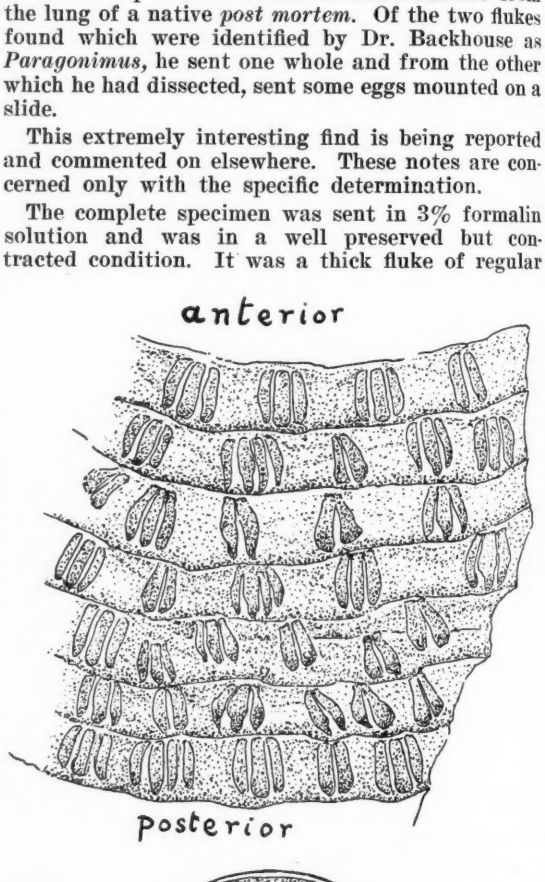

FIGURE I.

Camera lucida drawings of an ovum and of the spines in a portion of integument from the ventral surface between the suckers. The magnification is not the same in each case. The sizes are given in the text.

blunt ended oval form when viewed from above or below. The dorsal surface was more convex than the ventral. The length was 6·8 millimetres and the breadth 5·0 millimetres. The anterior sucker was near the anterior extremity, but looked more ventrally than anteriorly. The ventral sucker was very slightly in front of the middle of the fluke. The distance between the centres of the suckers was 2·7 millimetres. The transverse diameter of the ventral sucker was about 0·8 millimetres, the antero-posterior diameter slightly less. In this worm the oral sucker appeared to be slightly larger than the ventral. The genital pore was situated immediately behind the margin of the ventral sucker and very slightly to the right.

After examination of the external features parts of the integument were removed for examination of the spines and the worm was then stained and cleared. Later serial sections were made. All the main features of the internal anatomy were made out and agreed with the descriptions of the genus. The worm was mature and the uterus packed with ova. The viscera were in the commoner and not the transposed arrangement, the uterus being on the right side, the ovary on the left and the left testis slightly further forward than the right.

According to Ward and Hirsch[1] the characters of the spines are the most reliable means of differentiating the species of the genus *Paragonimus*. Vevers[2] also in his recent revision of the genus lays stress on the spines and also on the ova as providing the only reliable specific characters. On the other hand Kobayashi[3] does not accept the conclusion of Ward and Hirsch that the genus can be divided into species by the characters of the spines nor by any other characters. If we accept the conclusions of Vevers that there are four species of *Paragonimus* separable by the characters of their spines and ova, then the New Guinea specimen must be referred to the species *ringeri*. This is the species which infests man and the dog and cat in Japan and China. The other species are *Paragonimus westermanii* found in India and Malaya, *Paragonimus compactus* in the same countries and *Paragonimus kellicotti* from the pig, dog and cat in America and the tiger in Malaya.

As regards the eggs, unfortunately none was removed from the whole specimen received before it was sectioned. The eggs from the other fluke, received mounted on a slide, had been removed from the uterus, but from what part of it was not stated. They were well preserved. In most of them there was a crease along the side due to shrinkage which affected the breadth but probably not the length, which may, however, have been slightly increased by pressure. The average length of the five best specimens was 0·093 millimetre, the extremes being 0·0938 and 0·0908 millimetre. The breadth of one specimen which was not creased, was 0·056 millimetre. The measurements given by different observers of the eggs of the different species are not all in accord; according to Vevers's figures the egg of *Paragonimus ringeri* is the largest, the average measurements being 0·09 by 0·055 millimetre. Vevers also states that the eggs of *Paragonimus ringeri* and *Paragonimus kellicotti* are distinguished from those of the other two species by the presence of a thickening of the shell at the pole opposite to the operculum. This thickening was a prominent feature in the eggs from Rabaul and is shown in the figure. The evidence from the eggs, therefore, accepting the criteria of Vevers, points to the species being either *ringeri* or *kellicotti* and perhaps very slightly favours *ringeri* which has the longer egg of the two.

Examination of the spines, however, made it clear that the worm must be referred to the species *ringeri*.

The drawing shows the spines in a part of the integument between the oral and ventral suckers rather to one side of the median line. They are arranged in irregular transverse rows, the points directed backwards. In this specimen the points of the spines were frequently covered by a thin layer of cuticle instead of projecting beyond it. In the drawing which was made with a *camera lucida*, the irregularity in arrangement of the spines is slightly exaggerated owing to damage which occurred in preparing the specimen. Owing to foreshortening the length of the spines is less in relation to their breadth than the true relation. A few spines from the same region which had become detached and were lying flat, were measured and found to be about 0·025 to 0·0235 millimetre in length. The spines are arranged in groups of from two to four. This arrangement in groups according to Ward and Hirsch who first drew attention to the spines as specific characters, is characteristic of *Paragonimus ringeri* as compared with *Paragonimus westermanii* and *Paragonimus kellicotti* in which the spines occur singly. Vevers agrees with Ward and Hirsch, but finds that the spines in *Paragonimus compactus* are also arranged in groups.

This specimen must, therefore, be referred to the species *ringeri*, since the character of the ova excludes *Paragonimus compactus;* the shape of the individual spines is also more like that figured by Vevers for *ringeri* than that figured for *compactus*. As already mentioned, Kobayashi does not accept the conclusions of Ward and Hirsch and claims that he has found spines of every variety as well as intermediate forms in specimens from Korea alone.

With reference to the molluscan intermediate host in New Guinea it may be mentioned that the writer while in Rabaul collected a number of operculated fresh water snails from a stream there. These were identified in Melbourne as *Melania truncata*.

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THE INFLUENCE IN HOOKWORM INFECTION OF THE SPECIES OF WORM AND OF THE RACE OF MAN AND ON THE CHARACTERS OF THE LARVÆ AS A MEANS OF DETERMINING THE SPECIES DISTRIBUTION.

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Australian Institute of Tropical Medicine, Townsville, Queensland.

Introductory Remarks.

The two hookworms proper to man, *Ancylostoma duodenale* and *Necator americanus*, usually placed at present in different subfamilies, differ considerably in morphology. The differences of a physiological nature at present known will probably be added to by future inquiry. Of these the most important is the well established fact that *Ancylostoma duodenale*, the cause of the classical examples of severe hookworm disease in tunnels and mines and of Egyptian chlorosis, is more pathogenic than *Necator americanus*. This difference was particularly investigated by Darling and others[1] in Malaya.

It is rather surprising that several of the best known modern text books on tropical diseases and parasitology neglect to emphasize or even to mention that the two worms are not of equal importance as producers of disease. Some hookworm campaigns have been carried through and elaborately reported on without mention of the species of worms concerned.

As to what degree of pathogenicity is possessed by *Necator americanus* there is even today great diversity of opinion, ranging from the belief that all infections even the lightest probably do harm to the view that the worm is practically innocuous whether present in small numbers or large. This sceptical attitude is probably to be found most frequently in medical men working among some of the black and brown races. The middle position, commonly held and supported by the International Health Board of the Rockefeller Foundation is that a few worms, especially if necators, do no appreciable harm but that many, even if necators only, cause more or less evident amounts of anæmia and other physical and mental damage. This is the often emphasized distinction between hookworm infection and hookworm disease.

The variety of opinion is doubtless partly explained by the fact that tolerance of infestation varies enormously with the diet and the state of nutrition, with the severity of physical labour, with age, from unknown causes classed as individual susceptibility and probably also with race.

In much of the voluminous hookworm literature, a great deal of which deals with people infected solely or predominantly by *Necator americanus*, the question of pathogenicity is taken for granted or there is a tendency to be unconvincing. There are some notable exceptions, however, which seem to furnish convincing evidence of morbidity due to heavy infections with *Necator americanus* alone in the populations and under the conditions investigated. The conditions very often include under-nutrition and sometimes overwork.

Negroes and some of the other dark races may be in a different position. The original home of *Necator americanus* is believed to be Africa and the natives of tropical Africa and races connected with them in their origins may have acquired considerable tolerance throughout the ages during which they have harboured this parasite.

A laborious investigation into the effect of hookworm and other worm infections on adult male negroes has recently been carried out in Sierra Leone by Gordon[2]. No investigation was made of the species of hookworms concerned, but the author quotes other figures for a ratio of ten to one between *Necator americanus* and *Ancylostoma duodenale* in Freetown. The conclusions drawn by the author from his figures are that they reveal no effect of hookworm infection on the hæmoglobin percentage, the physique and general fitness or the mentality, but that they suggest the possibility of some relation between a low standard of energy and very heavy infections with more than about 600 worms.

Observations in New Guinea.

The writer during three years in the Mandated Territory of New Guinea was struck by the elusiveness of hookworm disease of which he had had no previous experience. The Melanesian and Papuan natives, before the extensive mass treatments later carried out, had an infection rate of 100% or near it with *Necator americanus* and the average number of worms harboured was considerable, probably in the neighbourhood of one hundred. *Ancylostoma duodenale* was absent except for a few introduced by the Chinese in recent times. In the course of a number of experiments on adult male natives on the efficacy of anthelmintics given under various conditions it was found impossible to pick out beforehand by clinical signs and general appearance the boys who had a thousand worms from those who yielded only a few. The same impression of the difficulty of foretelling whether few or many worms would be found was derived from a series of 230 *post mortem* examinations. In none of the patients examined for suspected hookworm disease while the writer was at the laboratory of the Commonwealth Department of Health in Rabaul did the condition turn out to be of this nature.

Although the effects of hookworm infection in the natives were certainly not obvious, it is fully recognized that a carefully planned investigation might have revealed a definite effect on the blood picture or the physical development. Such an investigation in natives where malaria is endemic and malnutrition not infrequent would need a great deal of time and care to produce really sound conclusions. While in New Guinea where his access to literature was limited, the writer was inclined to attribute the resistance of the natives to the fact that only *Necator americanus* was present. It seems certain, however, that this is an inadequate explanation and probable that some racial tolerance has been acquired throughout the ages which have probably elapsed since these peoples became infested with the worm in the days before their migration to the Pacific.

ILLUSTRATIONS TO THE ARTICLE BY DR. D. F. MYERS.

VARIATION IN POSITION AND FORM OF THE DIFFERENT PORTIONS.

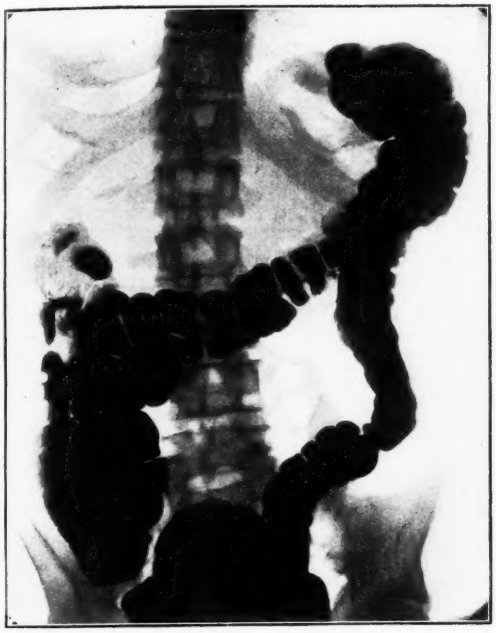

FIGURE I.
Not unusual course and position of the hepatic flexure.

FIGURE II.
"Figure of 8" sigmoid.

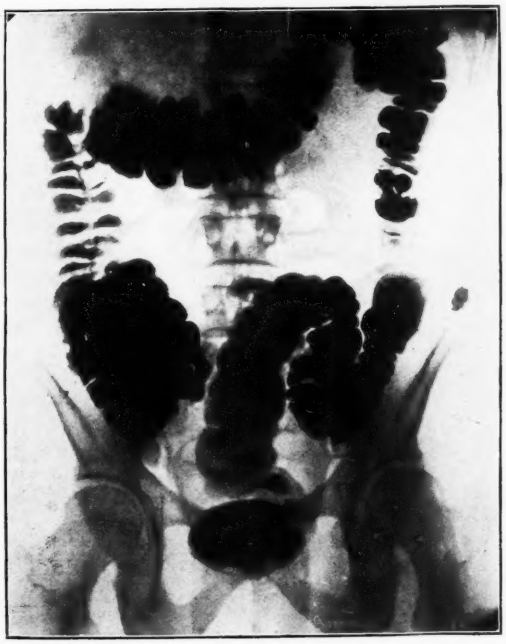

FIGURE III.
Rectum and sigmoid as one continuous long loop.

FIGURE IV.
The comparatively long sigmoid usual in childhood.

ILLUSTRATIONS TO THE ARTICLE BY DR. D. F. MYERS.

CONCERNING DEVELOPMENTAL FACTORS OF MIGRATION, ROTATION AND DESCENT.

FIGURE V.
High caecum. Fundus directed upwards. Appendix arising from the inner side.

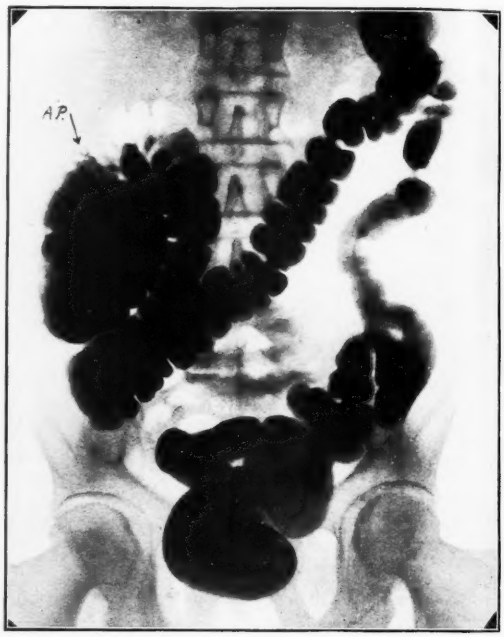

FIGURE VI.
High caecum. Fundus directed upwards; appendix from the outer side. Redundant descending colon.

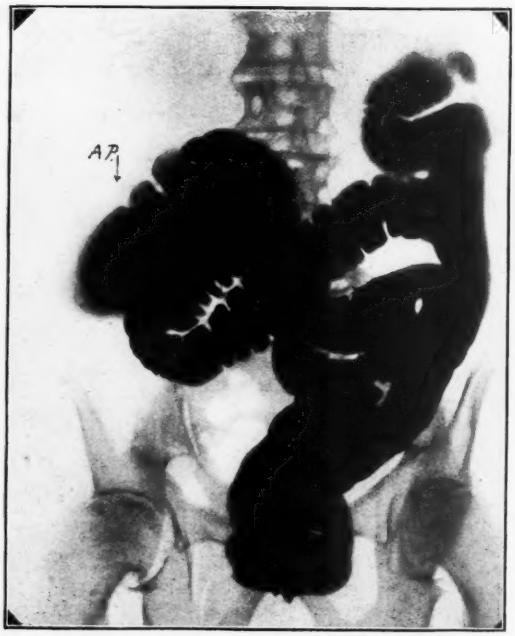

FIGURE VII.
High caecum. Fundus directed downwards; appendix from the outer side. Redundant descending colon.

FIGURE VIII.
Non migration. Left sided colon. Plate taken after enema and defæcation.

ILLUSTRATIONS TO THE ARTICLE BY DR. D. F. MYERS.

ABNORMALITIES OF POSITION.

FIGURE IX.
Transposition of viscera apparently complete. Corroboration by independent observer.

FIGURE X.
Unusual course of transverse colon. Abnormally short transverse meso-colon. Surgical confirmation.

FIGURE XI.
Transverse colon fixed high up under crus of diaphragm. Occurring in case of large chronic penetrating gastric ulcer. Diagnosis: Adhesions.

FIGURE XII.
Depression of the splenic flexure by large metastatic tumour mass in the left hypochondrium.

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ILLUSTRATIONS TO THE ARTICLE BY DR. D. F. MYERS.

PATHOLOGICAL CONDITIONS. ULCERATIVE COLITIS.

FIGURE XIII.
Ulcerative colitis. Whole colon involved. Narrow, non-haustrated, showing marbling of the luminal shadow. Incompetence of ilio-caecal valve. Rapid filling on screening.

FIGURE XIV.
Ulcerative colitis. Whole colon involved and markedly shortened.

FIGURE XV.
Ulcerative colitis. Ascending colon not involved.

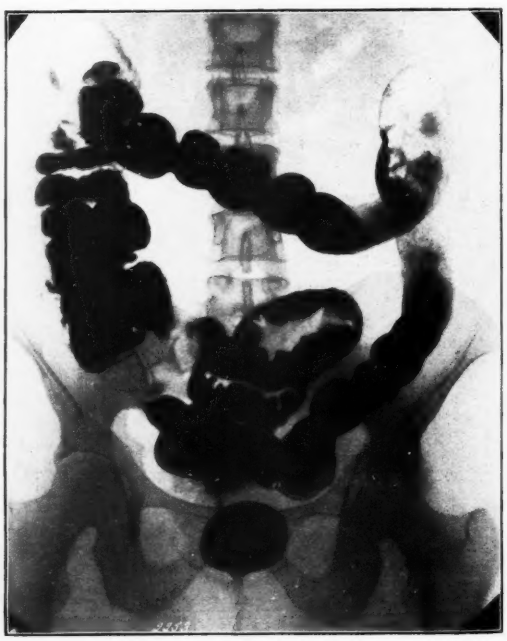

FIGURE XVI.
Ulcerative colitis. Ascending colon not involved.

ILLUSTRATIONS TO THE ARTICLE BY DR. D. F. MYERS.

PATHOLOGICAL CONDITIONS. TUBERCULOUS LESIONS.

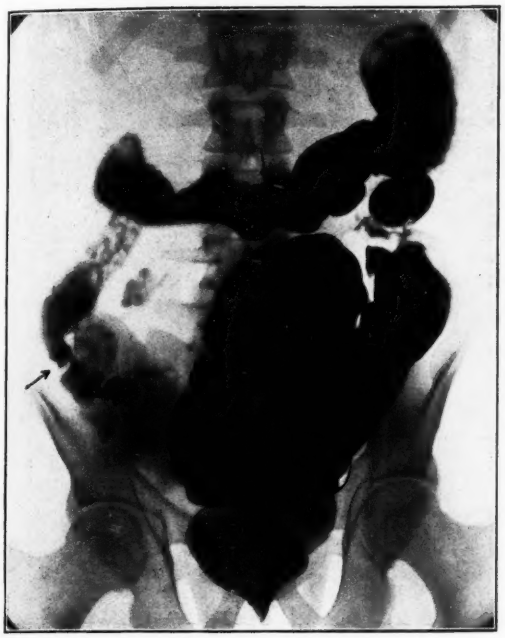

FIGURE XVII.
"Irritable" filling defect, deformity of contour. Extensive involvement (between arrows). Incompetency of ilio-caecal valve. Alternate filling and emptying under screen. Diagnosis: Tuberculous ulceration.

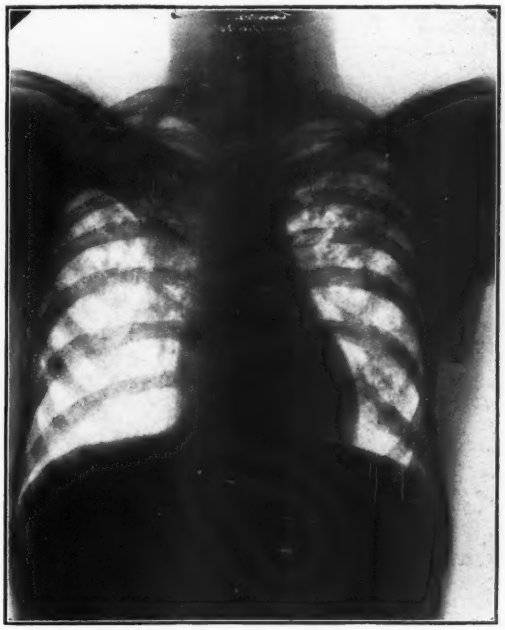

FIGURE XVIII.
Chest of same patient as Figure XVII. Extensive tuberculous involvement both upper lobes.

FIGURE XIX.
Normal radiograph of case with alternate filling and emptying of the ascending colon under screen. Extensive tuberculous bowel symptoms. Diagnosis: Ilio-caecal tuberculosis.

FIGURE XX.
Extensive defect F.D., palpable mass ascending colon. diagnosis: Carcinoma. Two years later similar skiagram; no tumour mass; pulmonary tuberculosis and dactylitis. Revised diagnosis: Hypertrophic tuberculosis.

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ILLUSTRATIONS TO THE ARTICLE BY DR. D. F. MYERS.

PATHOLOGICAL CONDITIONS.

FIGURE XXI.
Extra luminal shadows "arrows" sigmoid and iliac colon. Some deformity of contour. Typically hypersthenic colon. Diagnosis: Diverticulitis with early inflammatory changes of bowel wall.

FIGURE XXII.
Same patient as in Figure XXI after defæcation; shows greater number of extra luminal shadows and the deformity of contour to greater advantage.

FIGURE XXIII.
Multiple central filling defects N.S., of sigmoid and iliac colon. Screening also showed filling defect of rectum. Diagnosis: Multiple polypoid tumours. Confirmation by sigmoidoscopy.

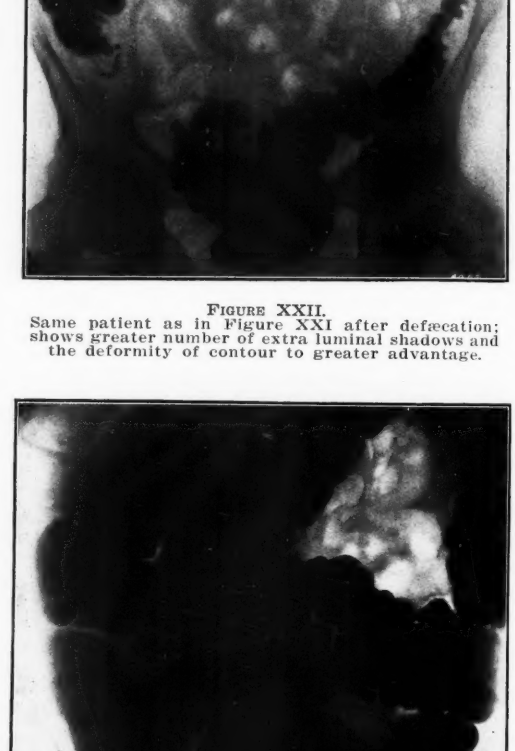

FIGURE XXIV.
Redundant dilated colon. It is possible that the redundancy might have been a causative factor in the dilatation, but the condition is probably a form of Hirschsprung's disease.

The Position in North Queensland.

In Townsville in the North Queensland coastal area a limited experience of ancylostomiasis has revealed a very different picture from that of New Guinea. The infection rate is far lower, but several patients with severe hookworm disease with very advanced anæmia have been seen and investigated. They have been white adults who have acquired heavy infections in the sugar farm districts. The cases of serious disease encountered so far, however, have been caused by *Ancylostoma duodenale*.

There can be no question that the investigation of ancylostomiasis in a country should include the determination of the prevalence and distribution of each species throughout it. In Queensland the position seems to be of particular interest as both species are present and seem to have an irregular or patchy distribution. Owing to the practical difficulties of applying the only method hitherto at their disposal, that of worm counts, the conclusions of the Australian Hookworm Campaign as to the distribution of the two species may require modification.

In North Queensland coastal area both species are common enough. Cases of pure or nearly pure infections with each species as well as mixed infections occur. The common occurrence of *Ancylostoma duodenale* was noted by Breinl before the days of the Hookworm Campaign[3] and in the museum of this Institute are numerous specimens of both species collected by him. Of a number of observations recently made one may be mentioned. Cultured larvæ were examined from two infected children in the Townsville Orphanage. In one who had come into the Institution from a district North of Townsville six months previously, only larvæ of *Necator americanus* were found, in the other who had been eight years in the Orphanage, only larvæ of *Ancylostoma duodenale*.

Hookworms have probably been imported into North Queensland from two main sources, *Necator americanus* by the Kanakas from the Pacific who formerly worked in the cane areas, *Ancylostoma duodenale* by southern Europeans of whom a good many are now settled in certain parts of the country. A certain number of both species have probably been brought in by the Chinese also. Remembering that the country is not thickly populated and the comparatively recent date of hookworm introduction we seem to have a probable explanation of the patchy distribution of the two species. What hookworms if any were originally harboured by the aborigines of Northern Australia is unknown and unfortunately it is now probably too late to find out. The Hookworm Campaign found *Ancylostoma duodenale* in some of them, but whether handed down from their remote ancestors or acquired in more recent times from Chinese or Japanese visiting the northern coasts can now probably never be known.

The Worm Count Method of Determining the Species Distribution.

The only method hitherto available for finding out the species distribution of hookworms in a country has been that of worm counts which consists in the examination of the stools passed for two or three days after an anthelmintic. The method has obvious practical difficulties especially in a white community and cannot be applied on a large scale even to native races. The difficulties met with doubtless explain the meagreness of information as to species often noticeable in reports of foreign hookworm surveys.

The Method by Examination of Larvæ from Fæcal Cultures.

A more practicable method is evidently needed. Several writers have described differences between the larvæ of *Necator americanus* and those of species of the genus *Ancylostoma*, although others have reported that no easily recognizable differences could be found. The eggs of *Necator americanus* and *Ancylostoma duodenale* also differ in measurements, but not sufficiently to afford a means of determining the species without the laborious process of measuring large numbers and plotting the results.

The writer has made a study of the "mature" larvæ, that is those which have reached the infective stage beyond which no further development takes place outside the body of the host. As a practical diagnostic method it is much more convenient to work with this stage than with the earlier ones when the morphology of the larvæ is rapidly changing. It has been found that the differences between the mature larvæ of *Necator americanus* and those of *Ancylostoma duodenale* are in fact striking and readily seen after a little experience. The generic diagnosis can be rapidly made from either living or suitably preserved larvæ with an objective of one-sixth or one-third of an inch focal length or even with a two-thirds and a fairly high eyepiece.

Herein a sufficiently simple and practicable method of species determination is available in routine hookworm work and surveys. It has already been tried here on the specimens collected by one of the units of the Australian Hookworm Campaign. The small fæcal specimen ordinarily obtained in hookworm surveys is divided into two parts and if ova are found in one of them, the other is cultured with earth in which nematodes have been killed by heat. After about a week at a suitable temperature the larvæ are isolated by the Baermann method or a modification of it. One should be used which prevents the passage of any but the finest particles of earth. The larvæ are then mounted and examined either alive or suitably fixed and cleared.

By this method it can be determined readily which species is present or whether both are, provided the disparity in numbers of the larvæ obtained is not too great. In very light infections, of course, no larvæ at all may be got. Details of the methods of culture and isolation used which cannot be gone into here, affect the chances of success very much. The method at present throws little light on the relative numbers of worms harboured by an individual, even if the proportions of the larvæ obtained be found by counting. The relative egg laying rates of *Ancylostoma duodenale* and *Necator americanus* are at present unknown, although much work has been devoted to the attempt to determine

that of *Necator americanus* and that of *Ancylostoma duodenale* is believed to be greater. Further there are no means of knowing whether the ratio of mature larvæ obtained to eggs cultured in the case of one species is at all similar to that in the other. In fact different cultures from the same specimen often give different relative numbers of larvæ. It never happens that all the eggs produce mature larvæ. No doubt it would be possible to make the larval environment in different cultures more uniform, but difficult to make it identical when different fæcal specimens are used.

Details of the features by which these larvæ may be distinguished as well as observations on the mature larvæ of *Ancylostoma braziliense* and *Ancylostoma caninum* of the cat and dog and of the methods employed will shortly be published elsewhere.

The method is, of course, applicable to the examination of specimens of earth from localities suspected of containing hookworm larvæ, an important procedure in routine hookworm control work. It has been tried here with specimens of earth forwarded from other parts of Queensland. The hookworm larvæ isolated, usually, of course, accompanied by numbers of free-living nematode larvæ, can be diagnosed as belonging to the genus *Necator* or that of *Ancylostoma*, but the separation of mature larvæ of *Ancylostoma duodenale* from those of the dog and cat ancylostomes is another matter and cannot be done with ease and certainty.

Summary.

The fact that the two species of human hookworm have not the same pathogenic importance is emphasized, as well as the need to determine the prevalence and distribution of each in survey and control work. The practical difficulties of attempting this by the method of worm counts are pointed out and a better method suggested, that of examination of larvæ cultured from small fæcal specimens.

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SECTION VI.—OPHTHALMOLOGY.

NON-SUPPURATIVE INTRAOCULAR INFECTIONS (INCLUDING RETROBULBAR NEURITIS)

By HERBERT F. SHORNEY, M.D. F.R.C.S.,
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CONSIDERATION of the structures liable to be affected under the title of non-suppurative intraocular infections comprise affections of the iris and ciliary body, of the vitreous, of the chorioid and retina and of the optic nerve.

These will be dealt with under the headings of ætiology and treatment.

Ætiology.

Intestinal auto-intoxications are in some cases claimed to be the cause of iritis and cyclitis.

In affections of the teeth and gums, the tonsils and accessory sinuses the factor concerned is toxic material formed as a result of bacterial action on and in the diseased area. Recently a discussion took place in London on the frequency of focal infection of the optic nerve and nerve head diseases of the accessory sinuses. The consensus of opinion appeared to favour the incidence of optic neuritis rather than the retrobulbar condition. As far as my own experience goes it would seem that the affection has been rather that of a descending retrobulbar inflammation accompanied as it not infrequently is by some inflammatory reaction of the nerve head visible by the opthalmoscope. I raise this point purposely with the idea of obtaining the views and experiences of members.

The next factor is metabolic disorders of which diabetes is the type.

The fourth ætiological cause is diseased organs producing altered chemical action from hypersecretion (Basedow's disease) or hyposecretion (as in cyclitis). In tetany we see optic neuritis. In nephritis we have two views as to the causation of the eye lesions. According to Zur Nedden the retinal changes are due to toxic matter formed by the decomposition of kidney substance which possesses a special affinity for the retinal tissues. The older view is that the connexion between the two states is found in vascular changes, in the increase of blood pressure or in the retention within the body of sodium chloride owing to its insufficient excretion by the kidneys.

In the fifth place there are the parasitic causes. Tuberculosis may involve the iris, ciliary body, chorioid, retina or optic nerve, as may syphilis. Microorganisms may infect the globe endogenously without giving rise to suppuration.

Infection from perforating injuries of the globe that fall short of suppuration, or from intraocular foreign bodies may be a cause.

Endogenous infection may act by setting in action a chronic plastic inflammation, as for example, plastic iritis and similar affections from organisms from nasal, tonsillar or dental sources or from influenza. Again, we have tuberculosis, syphilis and gonorrhœa and the causal agent of rheumatism, all of which can be blood-borne to the globe as emboli, there to begin their specific reaction in the eye tissues. In endogenous infection of wounds the trauma of the globe determines the lodgement of circulating germs in this area through its lowered resistance.

Treatment.

Acute Iritis.

I give here a short account of the routine treatment. I am accustomed to use atropine sulphate 2% either as drops or ointment, combined with

"Dionin" 1%. A blister about the size of a two shilling piece is applied just outside the orbital margin; leeches are, as a rule, unobtainable. If the pupil does not dilate with these measures and no signs of atropine poisoning are noted, a crystal of solid atropine is introduced into the conjunctival sac. Foments or a thick pad of "Thermogene Wool" is applied over the affected eye. To allay pain and assist in the dilatation of the pupil a mixture of salicylate of soda is useful whether the causative agent of the iritis be rheumatism or otherwise. Mercurial inunctions by assisting in the absorption of the exudate, help to dilate the pupil; in case of intolerance to atropine, dubosine can be substituted. Diaphoresis by means of Dover's powder or pilocarpine hypodermically (six milligrammes increasing to ten milligrammes) is a useful adjuvant. Rest in bed should be ordered; the sound eye should be protected; attention to the bowels should be given and a suitable diet should be prescribed.

Acute iritis nearly always responds to intracutaneous, intramuscular or intravenous injections. The most popular and most easily obtained substance is unskimmed milk; this is given intramuscularly in the upper and outer quadrant of the gluteal region. This treatment leads to rapid absorption of exudates which is followed by dilatation of the pupil. Very important also is the relief of pain, which takes place more quickly by this measure than by any other form of treatment.

As regards dosage the following is a good guide. To a new born infant two cubic centimetres, to a child of six years five cubic centimetres, to a child from eight to ten years eight cubic centimetres, and to a child or person over twelve years ten cubic centimetres are injected. In severe cases in adults fifteen cubic centimetres may be given.

After bringing the milk to boiling point, the boiling is continued for four to five minutes only and no longer, in order that the albuminous contents be not broken up. The boiling is an attempt to sterilize the milk to avoid abscess formation. Pillat's rule is to give an injection, to follow up by another the next day, to give none on the third day, to inject again, if necessary, on the fourth day. In perforating wounds of the globe, I give the three injections as a routine measure, to clean up the inflammatory reaction and to sterilize the area. I thus also hope to avoid sympathetic ophthalmia.

Let me now review some of the principal substances that have been used in the treatment of intraocular infections.

I.—Chemical Agents.

"Afenil" is a combination of calcium chloride with urea. The dose for children is five cubic centimetres and for adults ten cubic centimetres given intravenously, if needful, every day. The first one to two cubic centimetres should be injected slowly; after the feeling of heat has passed off the full dose is completed. Given in this way untoward happenings can be avoided. It is contraindicated in organic heart disease. Through its calcium content "Afenil" comes into more intimate contact with the blood vessels and acts more directly and energetically than when given by the mouth. Ascher has demonstrated that aqueous humour withdrawn from the eye is poorer in albumin after "Afenil" injection than that taken away before its use. Chiari and Januscke have shown that injection of calcium chloride into the blood stream prevents the development of chemosis after the application of mustard oil to the conjunctiva of guinea pigs. Good results have been obtained by combining "Afenil" with "Salvarsan," with the additional advantages that "Afenil" is a sterile solution and that its use mitigates complications that may arise through the use of "Salvarsan." It is not suitable for intramuscular injection on account of the great pain, and amount of infiltration occurring at the site of injection.

Stejskal and others have shown that hypertonic solutions intravenously injected exercise a strong inhibition over exudation and promote absorption of the same; after extensive trial he used grape sugar solutions up to 50%.

"Alvonal" is a 50% sterile grape sugar solution. It was used first of all in indicanæmia, afterwards in eye conditions, specially some forms of which Elschnig maintains are caused by indican circulating in the blood stream. According to Maillard (who has shown the power of amino acids to combine with glucose *in vitro*) indican combines with sugar and passes into the liver which splits up the indican or at any rate renders it innocuous.

By laboratory tests it has been found after using this treatment that the blood becomes indican free. The contents of one ampoule are injected daily, proper provision being made for diet and regulation of bowels. A transient rigor is all that may follow. As a substitute for "Alvonal" a sterile 50% grape sugar solution can be made up and ten cubic centimetres may be given intravenously each day.

"Urotropin" is used as a 40% solution in affections of the optic nerve and in chorioiditis. Before injection the needle with which the solution has been drawn up into the syringe, must be freed of "Urotropin," in order to avoid the burning sensation which would otherwise be felt at the seat of the skin puncture. Transient hæmaturia and a skin rash may follow the injection; milk should be drunk to diminish the irritation of the mucous membrane of the bladder. Von Seto has shown that "Urotropin" can be found in the aqueous humour ten minutes after injection into the ear vein of a guinea pig; in thirty minutes the maximum concentration is present; this lasts for four hours.

"Trypaflavin" has not only a powerful bactericidal action, but also according to Stephan a tonic action on endothelial cells. This substance acts more effectually on streptococci than on staphylococci. From the manufacturer it can be obtained in sterile ampoules or as a powder; it can be injected intravenously in doses from forty cubic centimetres to one hundred cubic centimetres of a 0·5% solution. The liquid is sensitive to light, but not destroyed by boiling. It is contraindicated in acute hæmorrhagic nephritis; injected near a vein it produces an infiltrate.

"Argoflavin" can be used in doses of fifty cubic centimetres of a 0·5% solution intravenously in similar cases.

"Rivanol" is a colour substance and like "Trypaflavin" derived from "Acridin." Morgenroth found that streptococci in the subcutaneous tissues of a mouse were killed by an injection of a 1 in 40,000 solution in twenty-four hours. Streptococcal phlegmon in a mouse was cured by direct injection of a 1 in 4,000 solution; it is non-poisonous to the tissues. "Rivanol" can be used intravenously in doses of fifty cubic centimetres daily; also as a 1 in 1,000 solution injected directly into the infected area, ten to twenty cubic centimetres according to the extent of the lesion. It should be freshly prepared, as it soon decomposes. Puncture of the anterior chamber showing the presence of organisms in the aqueous humour will give the indication for its use. It is not used in perforating wounds of the globe.

"Collargol," "Electrargol" and similar preparations are not so effective as the above.

"Atophan" and "Atophanyl," a combination of "Atophan" with salicylic acid, act by virtue of their analgesic and antiphlogistic properties and especially in iritis. They induce a lowering of central sensibility, accompanied by a miosis which as was determined from experiments on the eyes of guinea pigs, can overcome the action of atropine. When the injection was given, as soon as the inflammatory process began to clear up, mydriasis took place. As an example of its power to check exudation and transudation, Salus states that chemosis induced by "Dionin" did not occur. Both these compounds may be given at first intravenously, later by intramuscular injections up to three ampoules *per diem*.

"Bismogenol," a white powder, is salicylate of bismuth and is especially adapted for out patient practice. It is painless on injection, seldom causes stomatitis and never kidney irritation. The dose is 1·0 to 1·5 cubic centimetres intramuscularly every fourth day.

It is better to obtain bottles containing fifteen cubic centimetres which can be well shaken up, than the ampoules of only one cubic centimetre capacity. Fifteen injections comprise a course of this treatment.

"Spirobismol" has a red colour; it consists of a combination of bismuth, iodine and quinine and is possibly more potent than "Bismogenol." Its only disadvantage lies in the fact that unless the injection be given into the actual muscle substance, it causes much pain. "Spirobismol" is packed in containers of one cubic centimetre or fifteen cubic centimetres. The course is fifteen injections of two cubic centimetres at a time. If given alone, it should be injected twice a week, if with "Salvarsan," once a week. The same precautions are observed as with mercury in regard to stomatitis and the like. Reports on the treatment of luetic eye affections are favourable without exception, both in congenital and acquired syphilis, in iritis, neuritis, retinitis and chorioiditis, also in incipient optic atrophy. Care must be taken that the solution does not enter the blood stream. Gourfein also reports the cure of six cases of undoubted eye tuberculosis. In experiments on animals it was found that after injection of tubercle bacilli into the anterior chamber of the eyes of guinea pigs, followed by "Spirobismol" injection, the infection of the eye and the involvement of other organs were prevented. The control animals succumbed.

Sodium cacodylate and "Solarson" are given subcutaneously every second or third day to patients whose general condition is poor. It is packed in boxes numbered 1 and 2.

"Arsenelectroferrol" is used intravenously in doses of 0·2 cubic centimetre to one cubic centimetre every four or six days; two to ten injections are given. Twenty injections of "Astonin" each of one cubic centimetre every second day are employed. There is nothing special to mention about this last series of arsenical compounds; they are all well borne, without local or general reaction. Of course one must be on the watch for arsenical poisoning which is very improbable with these doses.

II.—Biological Remedies.

Milk (unskimmed) has been mentioned previously in the treatment of iritis and irido-cyclitis. Other uses are in cases of infected wounds or those in which infection is feared. In infections of the posterior portion of the globe and in sympathetic ophthalmia the results are uncertain. Some observers insist that this form of treatment is suitable only for acute infection, whilst others state that results have been favourable in subacute and chronic forms of eye inflammations. This method is also recommended in retrobulbar neuritis, albuminuria, vitreous opacities and vitreous and retinal hæmorrhages.

"Aolan" and "Caseosan" are milky substances, sterilized and put up by manufacturers ready for use, as substitutes for plain cow's milk.

"Hypertherman" is a milk solution combined with a cultivated saprophytic organism of the *Bacillus coli* group. It is used in smaller dose than milk, from 0·5 to five cubic centimetres intramuscularly at intervals of three to four days. The results are not better than those obtained from milk.

"Phlogetan" is given subcutaneously. The first injection is of one cubic centimetre; the dose is increased each time until five injections have been given. It causes some pain, but is much more painful when given intramuscularly. The results are the same as those of the preceding milk substitutes.

"Omnadin" has been introduced as a result of the conception that not only the albuminous elements, but also the fat and lipoid material of milk possess antigenic properties. "Omnadin" consists of reactive albuminous bodies which are the metabolic products of various apathogenic schizomycetes, combined with lipoid and fat. It causes a toning up of the body tissues with a mobilization of their defence mechanisms. Its range of use is approximately the same as that of protein therapy, in inflammations of every kind, especially to aid the action of tuberculin. For example, in tuberculous uveitis it is valuable, having the advantage over milk injection that it produces little or no febrile or other reaction and no after effects. Its action, however, is less ener-

getic than milk. Schnaudigel reports a number of cases of uveal tuberculosis treated favourably by "Omnadin" alone or combined with tuberculin. A daily intramuscular injection of two cubic centimetres in ampoule is given. The number of injections must be judged by the type of case and its progress under treatment.

"Vaccineurin" is made from virulent strains of staphylococcus and *Bacterium prodigiosum*. In the original package it is indefinitely stable. Injection is intramuscular or intermuscular in the upper arm. A course comprises eighteen injections, the ampoule being thoroughly shaken before use. Injections are given every third day in increasing concentration. There are three series, the first is preparatory, the other two curative. After the first injection local and general reactions are seen, pain in the affected nerves, fever and general malaise. The reaction begins in two hours (or may be delayed until the following day) and continues for twenty-four hours. The patient should be warned about the pain, as this is very little mitigated by ordinary analgesics. Infiltration around the injection area remains for two or three days, as a very hard and tender lump. According to the severity of the reaction, an alteration in the dose can be made. Intravenous injection is contraindicated on account of the very severe reaction. This vaccine is indicated in any neuralgia or neuritis of rheumatic, infective or toxic origin. It is especially useful in optic neuritis, also in paralysis of ocular muscles and in trigeminal neuralgia.

"Arthigon" helps greatly in gonorrhœal iritis. For intramuscular injection the dose is 0·5 cubic centimetres to two cubic centimetres, according to the amount of reaction, while for intravenous injection it is from 0·1 to 0·5 cubic centimetre. The patient must remain in bed as fever and malaise occur; one must adapt the dose to the general condition of the patient. As a diagnostic agent 0·1 cubic centimetre (in women half this amount) is injected intravenously. Characteristic of gonorrhœa is a rise of temperature of two degrees or more and a local reaction. "Arthigon" will not stand boiling. Antistreptococcal serum and autogenous vaccines may be mentioned in passing; their uses and dosage are too well known to need further comment.

Typhoid vaccine has been judged by many to be a close rival to milk in efficiency. Its great drawback lies in the fact that the intense headache resulting is considered by many patients worse than the disease; consequently a second injection is generally refused. Wagner Jauregg's malarial blood injection has come into prominence the last few years, since its first use in 1917. He uses blood from a benign double tertian malarial infection. In the earlier days the carriage of such blood from Vienna to distant parts was limited by the fact that the parasite died after from thirty to thirty-six hours. Lately hermetically sealed tubes containing citrated blood have been sent out, but I do not know how long this blood will remain active. The original technique was as follows: five to six cubic centimetres of blood were taken from the arm of a malarial patient by means of a sterile syringe. Only one quarter of a cubic centimetre was injected into a vein or under the skin. The incubation period is on the average four days, but varies from one to twenty-one days. After eight to ten rigors the Notch method of treatment is followed.

"Sanocrysin" is the gold compound introduced by Professor H. Möllegaard. A case of tuberculous iritis was treated by intravenous injection. There was no increase of temperature and only slight local reaction. Thereupon a 5% solution was used as eyedrops twice or three times daily for two and a half months; this led to absorption of the nodule.

Two other patients were treated without result. Sigurd Werner gives the results of the treatment of ten patients. In the majority there was no therapeutic result worth speaking of. Some showed an improvement, but not any quicker than with any other ordinary treatment. In a few cases the "Sanocrysin" made the eye condition worse. After subconjunctival injections no gold could be demonstrated in aqueous withdrawn from the eye when standard tests were used.

"Olyptol" consists of 10% oil of turpentine, 1% of "Eucalyptol" and 5% "Eucupin" in olive oil. It replaces oil of turpentine alone which has caused extensive tissue necrosis after injection. Lachmann states that the injection is painless having tried it on himself. The dose is 0·5 to 3·0 cubic centimetres intramuscularly and its use is in iritis, chorio-retinitis and vitreous opacities. The treatment is given at first every second day, later every day. Lachmann says that if no improvement occurs after five injections, he ceases treatment.

Light Treatment.

The rays from the quartz lamp have a special toning effect in the body and as such will have an indirectly good influence in chronic eye conditions. An undoubtedly favourable influence on scrofulous and eczematous skin conditions have been shown, but this lies outside the scope of these remarks.

The "Sollux" lamp is of no use in eye affections.

No good results have been obtained from Köppe blue light in iritis and irido-cyclitis.

The optimum dose of X rays has been found to be 20% Holyknecht's erythema dose when a zinc filter is used, especially in tuberculous iritis and irido-cyclitis. They react best of all in the granular form, those nodes which are characterized by lymph cell infiltration. Cyclitis and chorioiditis react to a very much less extent. In one case in which an eye with a perforating wound was treated with X rays, sympathetic ophthalmia occurred, the inference being that the X ray treatment determined its onset.

I have not been able to obtain any information to date about the results of diathermy in intraocular infections nor of treatment with radium. In chronic iritis and cyclitis we must try to discover the ætiological factor, such as absorption from teeth, tonsil, sinuses and so forth and deal with it.

Subconjunctival injections have been used extensively by me, sodium chloride solutions in increasing strengths from 1·5% to 10% either alone or combined with increasing strength of a 0·3% solution of mercury oxycyanide. In the same way

sodium cacodylate, guaiacol *et cetera* have been used. Repeated puncture of the anterior chamber for twelve punctures clockwise around the cornea every day or second day have been recommended. By this procedure the products of inflammation suspended in the aqueous humour are removed and it is claimed that local tissue metabolism is stimulated.

DR. A. M. MORGAN (Adelaide) said that he had found a distinct redness of the nerve head without swelling in retrobulbar neuritis. In the treatment of acute iritis he had given up the use of atropine crystals. He mentioned that atropine acted by paralysing the sphincter muscle and strong solutions were not necessary. He had seen cases of atropine poisoning through the drug getting into the stomach by way of a nasal duct. His experience of injection was confined to milk only; he had been disappointed with the results which he believed were no better than with the old medical treatment. He found that the patient developed severe constitutional disturbances, such as rigors and rises of temperature and became very chary about coming for a second injection.

DR. G. W. HARTY (Wellington) agreed with the speaker regarding the value of milk injections. He said that he had obtained good results in corneal wounds and hypopyon ulcer following trauma. He did not use it in the heroic doses recommended by Dr. Shorney. He found it very useful in small doses and always started off with a very small dose. He was in the habit of giving hypnotics in acute iritis when the pain was severe. He thought that they were apt to pay too much attention to septic causes of optic neuritis and to forget intracranial pressure which was the most common cause of optic neuritis. He mentioned that redness of the disc was quite common in cerebral hæmorrhage.

SIR JAMES BARRETT (Melbourne) agreed with Dr. Harty with regard to optic neuritis and intracranial pressure as a chief cause. He mentioned Cushing's experiment in driving pegs into dogs' brains; this caused a rise of pressure and œdema of the disc after a few hours. He had seen inflammation of the nerve head in syphilis; he was doubtful if it occurred in lead poisoning and stated that it rarely arose from septic diseases. Although he did not use blisters in the treatment of iritis, he did not think that any form of treatment should be rejected because it was not proved conclusively to be good in everyone's hands. With regard to sympathetic ophthalmia he had experience of sixty or seventy cases, but only one in the previous ten years. He had not used milk injections in treating the condition. He thought that many were syphilitic, but many were not. Prompt excision of the injured eye and the greater attention to asepsis were responsible for the lessening of the number of cases. During the war at the Dardanelles he had had much experience of eye injuries, but had not seen sympathetic ophthalmia. He recommended a solution of "Phenoline" as the most valuable drug in his experience for injection. It could be used by injection, intramuscularly or subcutaneously, without bad effects; it was also a local anæsthetic. The pain of acute iritis was nearly always a very intense pain and he found that large doses of sodium salicylate combined with sodium citrate were very useful for allaying the pain. As much as 2·4 grammes every two hours could be given. He congratulated Dr. Shorney on the work he had done.

Dr. Shorney in reply said he was glad that the previous speakers were in accordance with his views that it was a descending neuritis accompanied by congestion of the nerve head. In reply to Dr. Morgan he said that he always welcomed reaction after milk injections which he thought was necessary in the treatment. To Dr. Harty he said that his doses were those recommended by the originators of the method. They had been used for eleven years without any ill effects. With regard to treatment by blistering he thought that the serum might act as a form of protein therapy.

RED-FREE OPHTHALMOSCOPY IN THEORY AND PRACTICE.

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Historical Note.

THE results of original work are far reaching. They may spread to and may solve problems in unrelated spheres. The fertile mind of Professor André Broca conceived the idea of examining cutaneous lesions in filtered light.(1) He considered that reddish light was unsuitable for this work as the skin, especially when inflamed, was reddish too. Four years later in 1897 Neuschuler applied this idea to ophthalmoscopy. Ginestous and others continued the work. But little progress was made until the vision and industry of Professor Vogt surmounted certain difficulties. In 1913 he published the first of many articles illustrating the value of red-free light.(2) Since then Affolter and Koby, Gullstrand, Cantonnet, of Paris,(3) and Friedenwald, of Baltimore, have produced original work which has brought this method of examination to its present state.

The Yellow Macula: Its Discovery.

The yellow colour at the macula was for long a problem. It is laid down after birth and only in higher primates. Sömmering had first described it years before. Many considered it to be purely a *post mortem* change. Gullstrand latterly has been the great supporter of this view and Dimmer his great antagonist.(4) The latter had frequently observed the yellow colour during ophthalmoscopy with diffuse sunlight as the source of illumination.

Whether Vogt was stimulated to prove further the existence of this colour is difficult to say. But his first paper deals mainly with this discovery.

The colour of an object depends on the nature of the light leaving its surface by reflection and transmission. A red paper appears red because it reflects mainly red rays. The quality of the illuminating light also influences the colour of an object. The paper would be black or invisible in a light free from red rays. Lights rich in red rays, for example, candle, gas and low temperature electric lamps, will show a warmer, redder fundus than high temperature filament lamps and daylight. One accustomed to a carbon filament lamp is apt to diagnose a normal disc atrophic when using an intense tungsten filament lamp. Similarly the chorioid appears red because its pigment, hæmatogenous and otherwise, selectively reflects the red rays. The shorter rays are less penetrating and they are reflected by the retina. They, however, do not render the retina opaque and visible in ordinary light because of the preponderance of long red rays. It is convenient to call the red light reflected by the chorioid "the chorioidal light."(5) It renders invisible not only the retina, but also the yellow macula. In a similar way the sun appears red through fog and smoke because only the most penetrating rays reach the observer's eye. The preponderance of chemically

inactive red rays in the chorioidal light is one of the main difficulties in fundus photography.

If we lay a transparent yellow disc on a red background, it darkens the red but does not appear yellow in ordinary light. The yellow macula acts similarly. There is so little contrast between red and yellow that the latter is invisible. If we lay the disc on a white background, it appears less yellow by day than by electric light. The latter must be considered a yellow light, because it appears yellow by daylight.

Therefore to make visible the retina and its macula it is necessary to abolish the chorioidal light by filtering the red rays and by utilizing a light that is not yellow.

If we cut out all the red rays and attempt to examine the fundus, insufficient light remains to reveal any details. Therefore one must use an intense light. This was one difficulty which Vogt surmounted, and which had caused the failure of previous observers to see the yellow macula. Only an arc lamp or possibly the Pointolite lamp is of value.

As the crater of a small arc is about 4,000° C., it is necessary to eliminate the heat and also the violet and ultra-violet rays. The latter rays can cause so much fluorescence that in monochromatic violet light the lens becomes quite opaque. The lens and other media tend to convert the short rays into longer rays, as the skin pigment tends to convert light into the longer rays of heat.[6] Similar fluorescence occurs in the retina and especially in yellow areas.

In red-free light all rays except those between 410 and 560 are eliminated. The retina is then illuminated from in front and not from behind. The preponderating short rays are strongly reflected and refracted. Vogt uses a solid erioviridin filter for the orange-yellow and a 30% solution of copper sulphate twenty-five millimetres thick for the red and infra-red rays.

It is of interest to note that the range of rays most suitable for seeing the macula practically corresponds with the range which has no complementary colour, namely from 492 to 560. An alteration in the incandescent constituents of the sun, which would eliminate the rays between 750 and 560 would render the retinal superficial layers relatively opaque and so cause partial blindness.

Appearance of the Macula in the Enucleated Eye.

It is instructive to examine a normal eye removed during life. If one divides the eye immediately and examines the macular area, one can see a definite greenish tint. The *chorio-capillaris* is still suffused with blood and this colour is consequently not very distinct. In dark patients it appears less distinct. The exact colour varies also with the observer; this individual variation explains many of the contradictions in colour observations. If one divides the posterior half of the eye close to the disc and then dislodges the anterior from the posterior retinal layer under water by gentle shaking one can see the yellow colour clearly. Especially is this so if one holds the tissue over white paper. One then realizes how this yellow pigment is set in as a filter protecting the closely packed delicate cones. In this area 1,300 cones are packed into every 0·1 square millimetre. This filter is absent in albinos and consequently the violet and ultra-violet rays which pass through the media largely contribute to the painful glare of which these people complain. The correcting lens must, therefore, be able to absorb these rays.

After death the yellow pigment rapidly spreads through the perimacular tissue and later fades. It can be retained, however, if the anterior retinal layer is preserved in 3% nitric acid. The papillomacular area soon absorbs fluid and swells, forming the *plica centralis*. This change is possible because of the delicate nature of this cellular area and its freedom from fibre and supporting tissues. Similar changes must occur during life when the retina is affected by trauma, light or disease processes. This imbibition throws light on the cystic degeneration of the macula to be considered later. As the swelling occurs, the yellow colour extends to the posterior surface and peripherally. It often covers an area greater than one disc diameter. During life by red-free light it varies from one-third to one-half of this area.

The Yellow Pigment as a Filter.

Fixation is possible because the macula alone can discriminate fine detail. The delicate structure necessary for this evolutionary attainment is protected by this yellow filter. It is not found lower than the higher primates and in man is laid down after birth.

The value of the yellow pigment as a filter was emphasized by Clerk Maxwell. He described the spot or temporary scotoma which bears his name. The resting eye when first looking at a deep blue surface will show a dark area which quickly vanishes. Temporarily the effect of the blue filtration is seen and a dark area remains. Under certain conditions one can project this yellow colour and see a yellow area at the point of fixation. Ewald and Hering reported this phenomenon. Recently, quite unexpectedly, I had the opportunity of observing this for myself. After the use of 2% eserine Hess could see a yellow spot at the centre of his visual field.[7] The angle subtended by the yellow area, as seen by red-free light corresponds with the spots, seen entoptically in the negative form as Maxwell's spot and in the positive as the yellow spot.[8]

Sachs says that macular absorption commences in the yellow-green and gradually increases towards violet.[9] The yellow pigment of the senile lens has a similar spectral absorption. The yellow macula is richest in islanders and those exposed to most glare. They show a relative blue blindness. As our visual backgrounds in Nature are blue and green, namely sky, sea and vegetation, one wonders if lessening the intensity of blue increases the definition of the important details in the foreground. The green field is the smallest with the exception of violet, a colour very rare in Nature. Objects if of sufficient size and of any other colour but green

can be recognized in their true colour at the extreme periphery of the visual field.[10] This increase in the threshold for green may further aid our perception of detail. The reduced sensitivity to blue and green must lessen the fatigue produced by constant exposure to these colours and so increase the definition of objects on the background of vision.

These observations throw light on the value of this area physiologically and on the changes observed in pathology.

The Macula in Ophthalmoscopy.

In ophthalmoscopy this area is most important and yet it is neglected. Apart from albinotic eyes it is practically always present. Dimmer, Vogt and von Szily rightly urge that the yellow area be called the *macula lutea* and that the disc-sized surrounding area, demarcated by the ring reflex moving with the observer, namely the macula of Roster, be called the *fovea centralis*. The macula covers one-third to one-half of the *fovea*. In the centre is the minute foveola with its reflex moving against the observer.[11] Adherence to this suggestion will lessen confusion. The yellow colour varies from a pale straw colour through an intense canary yellow to a dark greenish-black. The last shade appears in dark patients, especially if the light be not accurately focussed. Würdemann states that the macula appears yellow in certain races by ordinary light.[12] The retinal pigment epithelium is denser in them and it acts as a filter for the chorioidal light. The yellow macula may appear in pathological eyes by ordinary light, if the red chorioidal light is absent. This occurs when the underlying retina or chorioid becomes opaque as a result of ischæmia or œdema or when the chorioid atrophies and the white scleral light shines through.

The yellow area may be enlarged, diminished or absent. In a case described by Koby diffusion was so great as to enable him to see the yellow colour by ordinary illumination.[13] Its diminution has been described in retinitis, severe contusions,[14] cachexia and toxic amblyopia. Vogt explains its disappearance in the last condition by the solubility of the pigment in alcohol. He has published notes of two extensive Swiss families with absent yellow pigment. Males only are affected and though the body is normally pigmented, the eye is albinotic. The *fovea* is not differentiated and the reflexes are absent. Nystagmus is usually present and certain members manifest aniridia.[11]

The macula may be displaced in detachment of the retina and in chorioiditis. Red-free light enables one to locate it in these conditions when other methods fail.

Prior to the introduction of this light cystic degeneration of the macula was known only anatomically; now it can be diagnosed during life. It occurs in irido-cyclitis, early *retinitis pigmentosa*, detached retina and other conditions. In central retinal thrombosis the cysts may be filled with blood which alters with posture, as in a hyphæma.[15] Gullstrand's binocular ophthalmoscope reveals a protrusion which replaces the normal macular depression. Often the reflex alters so that it resembles that of a convex rather than a concave surface. After months or years degeneration occurs and a hole appears where the cystic œdema was present. There is no swelling round this type of macula hole as occurs round those due to trauma. This condition explains many cases of irido-cyclitis with clear media but considerable visual loss. It may be an early change in conditions which are later associated with nystagmus or amblyopia.

The Visible Retina: Fibre-Striation and Mottling.

In ordinary light, especially in patients below fifty, the retina gives one the impression of transparence or of space between the plane of the retinal vessels and the chorioidal background. A binocular ophthalmoscope makes this more obvious, especially when one studies the disc tissues. One then gains a very definite impression of space between the vessels and the chorioidal margin of the *porus opticus*. This lessens with age and disappears with atrophy. Red-free light removes this tissue-transparence.

When examining dark patients with a high intensity electric lamp, one frequently sees a certain striation especially along the temporal vessels. This striation becomes visible in most cases over the entire central area in red-free light.[16] It is due to the radiating nerve fibre bundles. The papillo-macular fibres cause the finest striation and run horizontally. Above and below them other fibres curve as they leave the yellow macular margin and run towards the disc. The fibres temporal to the macula form a *raphé* as they cross the horizontal meridian of the eye. The remaining striation runs upwards, inwards and downwards towards the disc. In the retrobulbar neuritis of disseminated sclerosis and in toxic amblyopia the fine striation between disc and macula is often replaced by a fine marbling or mottling showing white diffuse areas irregularly arranged. In optic atrophy this change is more or or less generalized. This is the first objective sign of retinal atrophy. Vogt says that complete absence of striation is the rule in blindness of a year's duration. Vogt describes a fundus in which marbling was due to a blockage of the central artery, but normal striation was present in the area supplied by a cilio-retinal vessel.[16] In early retinitis and optic neuritis the striation becomes more marked. Later marbling may appear or the normal appearance returns.

Capillary Plexus of the Retina.

The dark patients who in ordinary bright light show the striation along the temporal vessels, sometimes also show minute capillaries in the same areas. As one would expect the fundus vessels and hæmorrhages by red-free light instead of being red on a red background appear black on a green-white ground. This contrast enables one to see the finest vessels and vascular changes. Fine vessels can be seen running right into the yellow area. Friedenwald, who uses a modified red-free light, has laid stress on the importance of the capillary plexus which can be seen covering the retina.[17] Minute vessels frequently appear to aid in the demarcation

of the nerve fibre striation by running along the fibres for a distance and then crossing. They can at times be traced to union with branches of the larger retinal vessels seen by ordinary light. Friedenwald has demonstrated two fine retinal plexuses, a profuse superficial network and a deeper sparser one. These vessels are much less visible in optic atrophy. Sometimes in optic atrophy one can see variations in calibre and almost invariably a white line along each side of the vessel wall. The importance of this appearance in atrophy was first emphasized by Vogt. It may be due to a light reflex similar to that seen normally along the centre of the blood stream. If so it must be distinguished from the white lines in arterio-sclerosis or after inflammation which are due to thickening of the normally transparent vessel walls or infiltration of the lymphatic sheath. The fine changes in the vessel walls in arterio-sclerosis form an interesting study.

Reflections from the Retinal Surface.[18]

The subject of reflexes is extensive and can only be touched on. They are wonderfully increased in red-free light and at first are confusing. They are mainly reflections from the surface of the internal limiting membrane. This and the superficial retinal layers reflect the short rays and the reflexes are very clear when the chorioidal light is obstructed. These reflexes are images of the reflecting area of the mirror and they vary in shape and movement with variations in surface of the various parts. One must study the concave foveolar and the convex foveal reflexes. The former is absent in most cases of retinal atrophy and its absence is always associated with defective vision. It is well known, when exaggerated, as the reflex of Gunn. Alterations in these reflexes may be the only fundus changes in patients with defective vision of obscure nature. Possibly œdema plays a large part in such eyes. I have found variable visual acuity and refraction and micropsia in such a case.

Other normal reflexes are vertical lines temporal to the disc and a concentric crescent on one or other side of it. Often there is a matwork of bright reflexes over the central area, interrupted only where the reflecting membrane crosses the vessels. All these reflexes become dull with age. Similarly, pathological reflexes due to traction, retinal atrophy and other causes may disappear with age. These reflexes are due to folds in the internal limiting membrane and the superficial retinal layers and as the reflexes fade, the actual folds appear as dull white lines or bands. Vogt has proved microscopically that these are actual folds.[19] They may radiate from the macula in cases of œdema or from the lower edge of a pre-retinal hæmorrhage or from retinal scars or exudates. At these sites the internal limiting membrane is more firmly adherent to the retina and so when swelling occurs, traction folds are produced.

Reflexes radiating from the macula are seen after trauma, during irido-cyclitis, keratitis, thrombosis, detachment and other conditions. Of particular interest is their presence in inflammatory lesions of the anterior ocular tissues. Fisher's recent article "Intraocular Lymphpaths,"[20] throws light on these cases. Recently I have observed a child with bilateral cyclitis, slight œdema of each disc and lines radiating from each macula, which were finer and more direct than those seen in renal retinitis. Vogt has seen folds due to œdema and cystic changes of the macula in *retinitis pigmentosa* before the pigment proliferation.

Corneal Staining in the Red Free Light.[21] [22]

In my experience red-free light is of little value in the examination of the vitreous and the lens. It enables one to see the yellow pigment of the lens which influences the fundus picture according to its intensity. However, it has a definite place in the external examination of the eye. Conjunctival and corneal vessels appear black and in great detail, especially with the *loupe*. But it is of the greatest use when one is investigating the corneal epithelium. The cornea is stained with fluorescein as usual and in red-free light the most minute area is found to be an intense green yellow. If one stains with a 2% solution of "Mercurochrome 220," the denuded area appears black on a bright background. By this means I have explained the presence of ocular discomfort and infection when ordinary light revealed no stained area. Quite unexpected dot and linear stained areas have been found by this method. "Mercurochrome" sometimes leaves particles of pigment on normal epithelium. They are easily distinguished from ulcers. It is of great interest to stain an ulcer with over-hanging edges with fluorescein and then with "Mercurochrome." By red-free light the deeper areas will appear stained by the fluorescein and the margin by "Mercurochrome"; 2% "Acriflavine" also may be used. These stains will sometimes reveal the superficial lymphatic channels and nerves. One can clearly demonstrate Fleischer's keratoconous ring by this method.

In the light of the recent work of Gallemaerts,[23] Verderame and others on intravital corneal staining the cornea becomes a more interesting structure. The differential staining of it and of the aqueous and examination by filtered light will lead to further discovery.

In conclusion there are a few practical points to emphasize. The most suitable lamp is the micro-arc sold by Zeiss. Only direct current is suitable. Only the direct method of ophthalmoscopy is practicable. A completely dark room and a patient with optic atrophy will lessen the difficulties of a beginner. The light should not be focussed through the pupil for more than a minute at a time.

The angle formed by the mid-line of the skull and the beam of light must be greater than that used for ordinary ophthalmoscopy and similar to that necessary for Gullstrand's central ophthalmoscopy.[24] The pencil of light should be circular, slightly divergent and directed so that its edge illumines the outer canthus. The best results require careful focussing.

The macula is best seen when the blue-green filter of Zeiss is used but other features are seen in better detail when the yellow-green light of Friedenwald

is employed.[25] A few grains of brilliant-green in a vessel with plane parallel walls acts admirably. The usual filter of copper sulphate for the heat rays is necessary.

Apart from the intrinsic advantages already referred to red-free ophthalmoscopy leads one to learn more from what one sees by the ordinary examination.

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DR. H. F. SHORNEY (Adelaide) said that he preferred a Schwartz lamp to that of Zeiss. He said that there were three important points about the use of the red-free lamp. It was extremely useful in the recognition of early optic neuritis; cystic maculæ could be recognized when the ophthalmoscope was of no use; minute hæmorrhages could be recognized which could not be seen by the ordinary ophthalmoscope. In his opinion the lamp was of great value and of special use in the diagnosis of early optic neuritis.

OPHTHALMOLOGY AND THE CONSULTING OPTICIAN.

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I should like to thank you for the honour your committee has done me in inviting me to open this discussion on ophthalmology and the consulting optician.

The difficult problem of the registration of sight-testing opticians has received consideration in Australia and more recently in New Zealand. In Australia, I understand, acts of Parliament for their registration and regulation have been passed in Tasmania, Queensland and South Australia.

In Britain a recent bill was rejected, while in New Zealand during last session of Parliament a bill was presented to the House of Representatives "to provide for the registration of opticians and to regulate the practice of optometry." It was read before the House, discussed *pro forma* and referred to the Health Committee to receive evidence.

In a chapter in a recent book[1] W. S. Inman maintained that while there is a tendency to break away from accepted beliefs as to the physical origin of certain diseases, ophthalmology seems to have remained behind. While admitting the obvious benefits of spectacles, he points out that headache is not invariably relieved thereby in cases in which it would be supposed that they might be curative and that other factors may be insufficiently investigated. He challenges our largely accepted view of the efficacy of correction of low errors of refraction and thinks that emotional stress is often a determinant of psycho-neurotic symptoms connected with the eyes.

While many may not accept his views, it must be admitted that cases occur which would appear to support them and in which factors beyond commoner methods of examination and treatment would appear to be present and which, it seems to me, have not always been estimated at their full value. Heredity, emotional strain and the stress of modern civilization, especially in school and industry, play a dominant part and promote attempts to relieve symptoms by the provision of glasses.

While of late years attention has been focussed on septic infections (teeth, tonsils and paranasal sinuses), the commoner maladies of childhood, which

are so frequently the forerunners and perhaps in many cases the cause of inflammatory eye conditions and errors of refraction, do not appear to receive the attention they merit. In the future the importance of the prevention, treatment and especially the management during convalescence of the exanthemata may receive more active care. In this connexion Sonder[2] refers to the frequency with which cases of high myopia may develope, especially when astigmatism is not corrected. The very prevalence of infantile maladies tends to mask their importance.

Progress in ophthalmology should modify our views on the ætiology and treatment of many refractive errors. The incidence of slight myopia in adults, for example, demands careful search for diabetes, glaucoma or early cataract and our methods of recognizing these conditions have improved during late years. Refinements in perimetry, tonometry and better operative methods on the one hand and the help afforded by the corneal microscope on the other, especially in the study of early lens changes, have altered the outlook materially. "It is a daily experience to find if the pupil be dilated, changes amply meriting the name of cataract in those who do not complain of the slightest trouble with sight."[3] And where these occur, especially to considerable degree in one eye only, the correction of an index error of refraction is not sufficient treatment, however gratifying it may be to the patient.

Constant progress is being made in observing and recording neurovascular changes, especially in association with the physician. It is these finer changes which make it difficult for other than a medically trained observer to discriminate between health and disease and this would appear to constitute the principal difficulty in affording State recognition to sight-testing opticians.

While many reputable opticians are careful to refer patients in whom they suspect possible disease to medical men, all are not so scrupulous. It may happen that a child with divergent squint is treated for several years by frequent changes of glasses without apparent benefit and with no suggestion that medical aid should be sought. Early cataract may be diagnosed and the patient told that nothing can be done until it is "ripe," in spite of the presence of obvious general disease or glaucoma may be ignored or, if diagnosed, the statement made as in one case that nothing can be done. While it is sometimes stated that registration would check irregular medical practice, it is difficult to see how this could be brought about unless registration were restricted to dispensing prescriptions for glasses; this suggestion is apparently not acceptable to the opticians. In this country there is a sufficient number of ophthalmic surgeons in proportion to the population in the principal and smaller towns and there are likely to be more, especially if after training more qualified medical practitioners are induced to undertake the work.

Before general discussion, it is desirable to remind you briefly of some important resolutions and reports in recent years.

At the Australasian Medical Congress held in Brisbane in 1920, Dr. Kenny[4] read a paper on this subject, when resolutions were passed and confirmed by the Section of Ophthalmology and by the final meeting of Congress. The resolutions read:

> 1.—It is dangerous to the public that opticians, however highly qualified as such, should be registered as sight-testing opticians;
> 2.—The treating of errors of refraction, such as long sight, short sight and astigmatism, by spectacles or otherwise cannot be safely carried out by other than fully qualified medical practitioners specially trained for the work.

In 1922 a valuable report[5] was prepared by the Council of the Ophthalmological Society of Great Britain on sight-testing by opticians wherein it is stated in reference to training that it "would warmly welcome any scheme which would lead to a greater efficiency in the making and fitting of spectacles and no course of training short of that required for full medical qualification can produce the skill and judgement necessary to meet the requirements." And "it is the opinion of the Council that any State recognition of sight testing by persons possessing only an optical qualification would not be in the interests of the community." It refers to the scientific principles of sight testing, largely developed by scientific research and to a great extent not available to the optician, to the frequent necessity for the use of drugs in estimating refractive errors, especially in children and also to the interdependence of eye defects and general disease. Finally it is claimed that it cannot be in the interests of the community to allow such grave responsibilities to pass into the hands of men with no medical training and to hall-mark by official recognition a practice involving such dangers.

In giving evidence before the Royal Commission on National Health Insurance, Harford [6] stated that in France anything like the examining and prescribing glasses by an optician was illegal and punishable. In Belgium opticians were allowed only to supply glasses according to the prescription given by the patient's doctor.

N. Bishop Harman[7] has pointed out that 5% of eye affections are associated with serious organic disease; these cases are scattered throughout the whole and commonly give no warning of their nature; often the complaint is made only of dimness of vision and request is made for glasses to see with. These patients commonly have some error of refraction, the correction of which materially improves vision, so that the optician may consider that he has done all that is needed by giving glasses, whereas the real root of the trouble has remained undisclosed. The remaining 95% of cases are by no means straightforward "optical" cases in which eyes as optical instruments independent of a human body may be dealt with by an optician with mechanical measuring instruments. Some 10% are myopes of more than low degree. Bishop Harman is amazed at the number of young people who come complaining of eye strain and headache, in whom there are found only very small errors of refraction, such as may be found in most, if not all,

of the population. While to the optician these may be cases for glasses, a wider investigation is commonly required and treatment is not necessarily confined to them. Such cases, most will agree, are very common in this country.

At the annual meeting of the British Medical Association held in Portsmouth in 1923 the following resolution was passed:

> That any State recognition of sight testing by persons not possessed of a medical qualification would not be in the interests of the community and ought to be opposed in the strongest possible manner.
>
> That the Council be instructed to take action in accordance with this decision.

At a meeting of the Council of the New Zealand Branch of the British Medical Association held on September 23, 1923, it was resolved that the resolution passed at the Representative Meeting at Portsmouth in July be adopted as a resolution of the Council. The above resolution was reaffirmed by the New Zealand Council in February, 1925. One notices that in the United States of America there is an Opticians' League of the State of New York which has as its objects: (i) To support by constructive work and purpose a dispensing policy that will support the highest ethics of the medical profession; (ii) to become the recognized body of dispensing opticians to whom the ophthalmologists will refer all their patients; (iii) to preserve and foster by mutual cooperation the practice of ophthalmology and the business of dispensing opticians; (iv) to refer to the ophthalmologist patients who come to the opticians in the course of business.

In England an association of dispensing opticians has been formed recently,[8] as "a result of the very general opinion of dispensing opticians throughout the country that the time has arrived for the formation of an organization devoted to the interests of dispensing section of the optical trade, membership being confined strictly to those engaged in optical dispensing work and divided into various grades."

The Minister of Health in Britain, the Right Honorable Neville Chamberlain, received in March last a deputation from the joint council of qualified opticians with which was associated the British Optical Association, to discuss a bill to procure the registration of optical practitioners and to regulate the practice of sight-testing and optical dispensing when he said that the whole of the difficulty was that defective vision might be due to simple errors of construction in the eye itself which could be mechanically corrected by glasses, to disease in the eye needing treatment apart from the provision of glasses, or to disease not localized in the eye, but due to a pathological condition in the body. If a case was not rightly classified, serious injury to the patient might ensue. Even if such a risk were confined to a very small percentage of patients, he would not be justified in submitting them to it, as he was advised that it was very serious indeed. The difficulty out of which he could not see his way was how patients suffering from simple errors of refraction could be distinguished from those in whom defective vision was due to some pathological condition.

It would be a matter for regret if, in a country which prides itself on sound legislation, there were created a profession within a profession and without special obligation.

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DR. A. M. MORGAN (Adelaide) said that they had a law relating to the registration of opticians and things were not much different from what they were before. In Adelaide the optician was not allowed to use drugs; he could not travel selling glasses unless he had a place of business and was registered. No unregistered person was allowed to test sight. Anyone, however, could sell glasses. There was nothing to prevent anyone going into a shop and picking out a pair of glasses which might suit him. The point was that no unregistered person was allowed to give advice about glasses.

SIR JAMES BARRETT (Melbourne) said that he was chairman of a special committee set up to meet the opticians in Melbourne and to discuss the matter. He said that he had told them that sight testing was wrong in principle and practice and that they should have nothing to do with anything apart from the actual fitting and making of glasses. He mentioned that there were some university authorities who wished to introduce something in the nature of a diploma in optometry. He deprecated such a scheme and especially the action of some professors of physics who looked upon the eye as only made up of certain curves. He pointed out that it took ten years to make a competent ophthalmologist, six years' medical course, two years' hospital experience of general work and two years' special eye work. He thought that the treatment and prescribing of glasses for myopia in children by opticians was greatly to be condemned. Children got glasses that they could see with and their cases were not properly investigated. He thought that there was no ojection to the registration of dispensing opticians and the medical profession would be willing to cooperate with opticians to promote scientific training and registration of such.

DR. H. F. SHORNEY (Adelaide) said that the course of instruction which was given in the University of Adelaide consisted of a three years' course, first year devoted to optics and light and so forth. The second year was devoted to elementary anatomy and physiology of the eye. When the optical society wanted to add training in the use of the ophthalmoscope and the recognition of diseases of the fundus, he refused to sanction it. The matter remained at that stage and would probably come up for further discussion.

DR. A. J. HALL (Dunedin) thought there would be no objection to the registration of dispensing opticians, but a board should be appointed to satisfy itself that those applying for registration were competent dispensing opticians.

DR. A. G. TALBOT (Auckland) doubted whether much could be done by the registration of opticians.

After discussion the following motion was proposed by Dr. Harty and seconded by Sir James Barrett:

> That this meeting is of opinion that since a medical and special training is required, (i.) it is not in the public interest to register and recognize sight testing or consulting opticians as such; (ii.) there is no objection to the registration of dispensing opticians and the medical profession would cooperate with the opticians to promote scientific training and registration of such.

The motion was carried.

DR. A. J. HALL (Dunedin) gave a lantern demonstration of fundus diseases. In a preliminary statement he said that he wished to show a series of slides prepared for him by Head. They were intended to be used principally for instruction for medical students. In the out-patient department experience had shown that many months of diligent work were needed for a student to acquire sufficient facility in the use of the ophthalmoscope to recognize whether a fundus was normal or not. Under these circumstances it would be futile to talk to them about diseases of the fundus and expect them to remember them. He, therefore, thought that it would be a desirable thing to present an exact replica of what the opthalmoscope revealed in common conditions until the student was able to look for himself. In showing these slides he said that, although they were all ordinary conditions, they could be studied by all with advantage. An effort should be made by ophthalmologists in Australia and New Zealand to collect something more than mere written records. They should be able to provide Congress museums with pathological specimens and pictorial reproduction of ophthalmic conditions of interest collected by themselves from their practices. It should be possible in the larger cities to arrange for a skilled artist who should be trained to use the ophthalmoscope in order to get first hand impressions of the picture he had to portray, to produce permanent pictorial records.

SECTION IX.—PÆDIATRICS.

Hirschsprung's Disease.

IN speaking on Hirschsprung's disease, DR. R. B. WADE referred to Hurst's theory of achalasia or failure of relaxation of either the internal or O'Beirne's sphincter as the cause of the disease. Such a condition could be explained either by Gaskell's theory that the action of the sympathetic was to prohibit the motor contraction or that of Royle and Hunter that the action of the sympathetic was for the fixation of postural tone. It was noted as a preliminary observation that four out of five patients recently under review had increased knee jerks. After consultation with Dr. Norman Royle an operation had been devised, namely section of the white ramus from the first lumbar nerve to the first lumbar ganglion, of the visceral branches to the inferior mesenteric ganglion from the first, second, third and fourth lumbar ganglia and section of the trunk below the fourth lumbar ganglion. The result in three patients had been a relief of all symptoms, distension and visible peristalsis in all. He read his notes merely as a preliminary communication of a new method of treatment.

DR. NORMAN ROYLE (Sydney) said that he regarded ramisection as a cure in Hirschsprung's disease. He had operated on a patient suffering from chronic constipation three years previously with complete recovery. In experiments on animals the spinal cord had been cut and the bowel and bladder dilated; the animal had died in three weeks from toxæmia, but if the sympathetic also was divided the animal lived indefinitely. He thought that achalasia was not the full explanation of Hirschsprung's disease. In fourteen cases of spastic paraplegia with chronic constipation the condition had been relieved by ramisection.

DR. R. B. WADE (Sydney), speaking after Dr. Royle, said that many years before he had seen a patient with Hirschsprung's disease operated on to see if any obstruction was present. None had been found. When the stitches had been taken out on the usual day, the whole wound had gaped, the intestines had protruded and the child had died. In operating on these patients during the acute phase there was a tendency to sloughing and gaping of the wound. Death might also occur as a result of toxic inanition. Many patients with Hirschsprung's disease died in the early months of life without a diagnosis being made, the cause of death being toxic inanition.

A description was given of the dilatation into *sella turcica* of the third ventricle that occurred in cases of congenital internal hydrocephalus, in which the blockage was in the aqueduct or roof of the fourth ventricle. An operation based on Frazier's method of approach for pituitary tumours was described.

SECTION XII.—RADIOLOGY.

REFLEX DYSPEPSIAS.

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In this short paper it is proposed to consider only two common types of reflex dyspepsia, namely those caused by (i) pathological conditions of the appendix, (ii) pathological conditions of the gall-bladder.

PATHOLOGICAL CONDITIONS OF THE APPENDIX.

In the first class I have reviewed a series of seventy unselected hospital and private patients who were referred for opaque meal investigation, in whom the X ray findings led to radiological diagnosis of a pathological condition of the appendix and all of whom were subsequently operated upon, so that it was possible to ascertain the degree of accuracy of the diagnosis.

In all the patients the main symptoms were referred to the upper part of the abdomen, so that the provisional clinical diagnosis sent with the patient was as follows:

Gastric or duodenal ulcer or gall stones	26 patients	= 37%
Chronic appendicitis	25 patients	= 36%
Gastric or colonic carcinoma	4 patients	= 6%
No provisional diagnosis sent	15 patients	= 21%

It must be pointed out that these patients were sent from various sources and that I do not wish to convey the impression that these figures represent the highest degree of accuracy in diagnosis which can be attained by clinicians without the aid of the radiologist.

At operation sixty out of the seventy patients, that is, 85%, were proved to have a pathological condition of the appendix with no lesion found in the other organs.

At this stage it is important to have a clear understanding what in this series has been taken to constitute a pathological condition of the appendix. By that term is meant an appendix with an obvious macroscopical lesion such as binding down by adhesions or inflammatory thickening and changes in the walls, with or without fæcal concretions or foreign bodies in the lumen. Where it was necessary to resort to microscopical examination to show chronic inflammatory changes, the appendix has been classed as normal.

In one case of the pathological group the appendix with the exception of the proximal half centimetre consisted of a large mucocele and its removal gave complete relief of symptoms.

An endeavour has been made to obtain the relative values of the different so-called direct and indirect signs on which a radiological diagnosis is based.

Significance of Visualization or Non-Visualization of the Appendix.

The variation in figures given by different observers for the percentage of appendices visualized and the variation in the significance attached thereto are extraordinarily wide. In my opinion over 90% of all patients examined with opaque meal will be found to have an appendix filled at some time during the course of the investigation, providing the examiner is willing to carry out thorough palpation with the hand under the screen, the patient being placed in various positions, especially the recumbent and the rays being restricted to expose a small area. The importance of visualising the appendix does not depend so much on the visualization itself as on the fact that it enables one to obtain considerable information as to its position, mobility, shape, emptying time and particularly its relationship to any tenderness present.

In twelve patients, that is 17%, the appendix was not seen at any examination and all proved pathological at operation.

Tenderness.

Tenderness is undoubtedly the most valuable sign and the tenderness may be accurately localized with one finger in its relationship to the visualized appendix or to the caecum when the appendix is not filled. In forty-eight or 80% of the patients whose appendices were proved at the operation to be pathological definite tenderness of more or less degree was present. In quite a fair proportion the appendix is easily palpable.

Mobility and Changes in Shape and Position.

Mobility, change in shape and change in position all have their value, but caution in interpretation of their significance is essential, for it must be remembered that the normal appendix varies considerably in the development of its mesentery and consequently in its degree of mobility. An apparently fixed appendix is not necessarily tied down by adhesions. Apparent kinks and angulations may be made to disappear by palpation or by rotating the patient to a different angle and its position may vary from one examination to another.

Stasis in the Appendix.

In thirty-two of the patients with demonstrated lesions of the appendix, that is 54%, there occurred stasis either in the appendix alone or in the caecum as well after the colon had completely emptied or, if any colonic contents remained, these were confined to the distal portion of the large bowel. In twelve patients, that is 19%, the appendiceal stasis was only part of a general colonic stasis. An appendix which remains filled after the colon has emptied, must naturally arouse suspicion as being one which drains poorly, but in the absence of other confirmatory evidence especially tenderness, one would hesitate to label the condition of the organ as definitely pathological. Of the ten patients found "not proven" at operation, in five there was stasis after colon had emptied, but in only one was any tenderness elicited.

Stasis in the Terminal Ileum.

Stasis in the terminal portion of the ileum was present in eight patients, that is 13%. Included under this heading are those conditions in which the terminal ileum had not emptied completely at the examination made 20 hours after the administration of the second meal (consisting of a suspension of barium sulphate in water) in the double-meal method adopted.

Reflex Effects in the Stomach and Duodenum.

As the symptoms of chronic appendiceal trouble are largely referred to the upper part of the abdomen, so also does one find in a number of patients distinct reflex signs in the stomach and duodenum, the most common being spasm, a sign which is so often associated with lesions of the gall-bladder. This spasm is described by writers as an indirect diagnostic sign and therefore a helpful one of a pathological condition of the appendix, but it has to be considered from the opposite aspect as well, namely, that it tends to mask the causative lesion and to direct suspicion to an area which is blameless. Therefore it is to be considered a confusing rather than a helpful sign.

In eight patients there was evident pylorospasm, in five with a delay in emptying of stomach as evidenced by a residue of the motor meal at six hours; in six patients there was found a small spastic duodenal cap, difficult to distend and emptying rapidly. So distinct were these signs in six of the patients that, in spite of the diagnosis of a pathological condition of the appendix having been made, an associated duodenal or gall-bladder lesion was suspected and in one case an associated pyloric lesion was diagnosed. In all these patients the operation undertaken for the removal of the appendix revealed no evidence of such a lesion.

This indicates the value of a point to which I now wish to refer, namely, the importance of an opaque meal investigation being carried on till the whole tract is examined thoroughly. It often happens that a patient is referred by a doctor with the request "for an examination of stomach and duodenum only." In some cases this is done because the patient is averse to giving up the time necessary for the complete examination, but in many cases it is probably because the practitioner is unaware of the extent to which these reflex findings may mask a lesion lower in the tract and lead to an erroneous diagnosis. From the point of view of the patient's welfare and in fairness to the radiologist on whose findings so much may depend, this practice except in special cases is to be deprecated.

I may summarize the conclusions as follows:

1. The complete barium meal investigation in cases of reflex dyspepsia has a distinctly high value in localizing the cause, especially when that cause is a pathological condition of the appendix.

2. The diagnosis of a pathological condition of the appendix must be made by a combination of the various so-called direct and indirect signs, the most valuable single sign being tenderness localized over a visualized appendix, the next in importance being stasis after the colon has emptied.

3. The reflex signs produced in stomach and duodenum may altogether mask the underlying lesion or at any rate raise the suspicion of another associated lesion in those organs or in the gall-bladder.

Pathological Conditions of the Gall-Bladder.

With regard to pathological conditions of the gall-bladder I wish to deal briefly with a few points of practical interest in the latest advance in gall-bladder technique, namely, cholecystography. It is not intended to discuss the procedure in detail, as much has been already written on the subject, but I propose merely to analyse my own experience with the method and to show some illustrative films. When cholecystography was first introduced, the radiological staff of the Melbourne Hospital with the cooperation of the surgeons examined a large number of patients by the intravenous and oral methods, but the results proved so variable and disappointing that for a time the investigation was practically abandoned. These failures were due to two reasons. The dye being unstable and having been imported from overseas, had undergone changes so that even with the intravenous method often no shadow was obtained; the keratin-coated capsules used in the oral method in many cases failed to dissolve. Arrangements were made later to have tetraiodo-phenolphthalein manufactured locally, this was placed in gelatine capsules freshly coated with a solution of keratin immediately before use. This routine has caused a great improvement in the accuracy of results and the investigation of a new series of patients by the oral method has been undertaken. The intravenous method does not seem likely to become a routine procedure and the oral method is therefore being used exclusively in this series.

Although a large number of patients has been examined, at present it has been possible to obtain operation findings in only twenty of these. In sixteen patients the X ray diagnosis proved correct, in two incorrect and in the remaining two it is classed as indeterminate for the reasons I will state later.

Among the sixteen in whom the diagnosis proved to be correct, a pathological condition of the gall-bladder was discovered in fourteen; in two the gall-bladder was normal.

Of the pathological cases in six there were calculi in the gall-bladder, in two a calculus in cystic duct and in one a calculus in both cystic and common ducts; one was inflammatory secondary to carcinoma of head of pancreas and the remaining four were inflammatory without calculi.

In the two failures what was interpreted as a normal response to the dye was noted. The first patient at operation was found to have adhesions to the pylorus and omentum and section of the excised gall-bladder disclosed inflammatory changes with destruction of mucous membrane in parts. In the second patient there was no obvious abnormality of the gall-bladder, but the clinical findings had been so distinct that cholecystectomy was done and the pathologist reported definite inflammatory changes with mucous membrane destroyed in places. These findings seem to make it justifiable to classify the two indeterminate cases as such, for these patients both proved to have chronic duodenal ulcers, one of them having so much thickening of surrounding parts as to necessitate inclusion of part of pyloric portion of the stomach in the excision. There was a doubt whether the condition was a malignant one until sections had been taken. Neither patient had obvious abnormality of the gall-bladder, which, however, was not opened; in view of the chronicity of the duodenal lesion it does not seem unreasonable to expect some degree of associated cholecystitis which would explain the absence of a shadow with the dye.

Thus if these two patients be excluded the results are sixteen out of eighteen correct or 88%.

Although this series of patients subjected to operation is too small at present to enable wide conclusions to be drawn, the results are most promising and with the figures now available from workers in other countries who have carried out investigations on a large scale, it would seem that this new technique is going to be a most valuable aid in determining whether in a case of dyspepsia the gall-bladder is or is not a causative factor.

I wish to express my thanks to Dr. L. J. Clendinnen, Dr. Barbara Wood and to all those members of the Melbourne Hospital medical staff whose cooperation made the publication of these results possible.

In reply to Dr. Myers, Dr. H. F. Praagst said that skiagrams of the gall bladder were taken twelve, sixteen and twenty-four hours after administration of the dye. Tenderness over the appendix itself varied, but the appendix was often felt when it was filled and it was possible to determine whether tenderness was present at that site or not. Dr. Praagst himself used the bare hand in palpation.

Dr. W. R. Stowe (Palmerston North) remarked that Dr. Nott estimated the resistance of the human body as being equal to sixteen millimetres.

Dr. Praagst stated that a vulcanite backing on top of the aluminium screen prevented the rays from striking the back of the hand, but that any other glove than a heavy examining glove was quite useless in protecting the palm.

Dr. Stowe remarked that the question of the dye for the investigation of the gall bladder was a very important one. Martindale had sent out drugs at a reasonable figure, but some method had to be adopted to insure that the drug was active when it was received. He suggested importing it from Australia.

Dr. Praagst stated that in Melbourne they were using "Kerosol"; this was imported in small quantities at a time, so that it could be used as fresh as possible. It was made up in ampoules the contents of which could be put in a keratin capsule and he expected that that method would be satisfactory.

In reply to Dr. Argyle Dr. Praagst stated that stasis might occur in normal appendices. It was not of diagnostic importance by itself unless other signs were present.

Dr. C. C. Anderson (Dunedin) in discussing the use of dyes for cholecystography stated that Mr. White was the first to make use of this method in Dunedin; he had found it quite satisfactory. They were using the intraoral method, the drug being placed in capsules with stearin; this method was quite satisfactory.

Dr. R. N. Guthrie (Christchurch) stated that he was very pleased to hear Dr. Praagst say that a pathological appendix could be palpated and tenderness could be located, as he had found surgeons who disagreed with him on these points. He had recently read an article in which it was stated that it was impossible to diagnose chronic appendicitis by radiological means. This he did not believe.

DR. S. S. ARGYLE (Melbourne) asked what the nature of the vehicle was which was used for barium meals. In reply Dr. Praagst stated that the first meal was a mixture of porridge and barium sulphate, while the second was a mixture of water and barium sulphate. This he found gave the best filling of the cap with least spasm.

Dr. Argyle deprecated the non-use of gloves while palpating under the screen; they should be used up to the last minute and removed when the appendix itself was to be palpated.

EXAMINATION OF THE COLON UTILIZING THE OPAQUE ENEMA: TECHNIQUE OF ADMINISTRATION.

By D. F. MYERS, M.B., B.S. (New Zealand),
Radiologist, Wellington Hospital.

THE material for this paper was afforded by the examinations of the colon carried out in the X Ray Department of the Wellington Hospital and to a lesser extent in private practice during the past two years.

By the opaque meal method it is the exception rather than the rule for the whole large bowel, at any one time, to be well filled by the contrast medium. The enema not only assures the complete filling which is necessary for satisfactory examination, but slightly distends the bowel wall and so makes the detection of pathological processes more certain. For these reasons there is no doubt that from the point of view of anatomy and pathology the enema is the method of choice.

In 1911 Professor Haenish, of Hamburg, made known his method of simultaneous opaque enema injection and fluoroscopy and it is this method which is now universally adopted.

I wish in this paper to stress the importance of the screen examination; it is as essential in the X ray investigation of the colon as in that of the stomach and duodenum. The varying appearances and behaviour of the bowel subjected to the enema, from the commencement of flow until the caecum has been reached and filled (if this latter be possible), provide the data for the diagnosis. It has been my experience that diagnosis based solely upon plate findings is often erroneous.

Preparation of Patient.

The whole colon should be empty and clean, but yet not in an irritable condition. The following is the preparation I have adopted.

A cleansing enema is given at night previous to the examination and another enema in the morning at least four hours before the examination. A light breakfast, such as tea and toast, is allowed after the second enema.

Enema Material.

The medium found very satisfactory is a starch one and the following are the details of its preparation.

Three level dessertspoonfuls of cornflour are mixed with a little cold water and then stirred into 850 cubic centimetres (thirty fluid ounces) of fresh milk with 340 cubic centimetres (twelve ounces) of water contained in a 2·8 litre (five pint) saucepan. This is brought to the boil with constant stirring. To this is then added 425 grammes (fifteen ounces) of barium sulphate which has previously been mixed to a cream with 511 cubic centimetres (eighteen ounces) of water and the whole again brought to the boil for two minutes under the same constant stirring.

The Injection of the Mixture.

This makes a 1·8 litre (three pint) enema of thin consistency which suspends the barium sufficiently well if stirred occasionally. It is put into a two and a quarter litre (four pint) douche can container provided with about one hundred and fifty centimetres (five feet) of rubber tubing ending in a good rubber rectal tube and is cooled to 37·8° C. (100° F.) for use.

The douche can with its contained fluid and with its tube governed by a clip is put conveniently by the side of the fluoroscopic table; with it are placed a fairly large bowl and a towel and guard, adhesive strapping, scissors, vaseline, a swab of cotton wool and rubber gloves if one wishes to use them.

The X ray room should be comfortably warm, so that the patient may have every aid to muscular relaxation.

The patient is most suitably clad in his usual night attire and lies upon the table on his side covered by a fair sized guard. The procedure is then briefly explained to him.

After the air has been expelled from the tubing, the rectal tube, lubricated at its tip, is introduced for a distance of about seven and a half to ten centimetres (three to four inches) into the anus under full inspection; a corner of the guard may be used by the hand in separation of the buttocks. If the sphincter appears to be relaxed or in the case of obvious hæmorrhoids and there is some doubt as to the retention of the tube, a thinnish strip of adhesive strapping is wound once round the tube and fastened to the buttocks. The patient is asked to lie upon his back and a doubled up towel is tucked firmly between the coccyx and the tube, thus serving to keep the rectal tube quite steady; the tubing is arranged so that there is no likelihood of kinking. The foot end of the table is now raised about thirty centimetres, the patient's shoulders being supported by an adjustable rest. The patient is instructed to lie comfortably with all muscles relaxed and to give immediate indication if he feels the bowel abnormally distended, the desire to defæcate, pain, movement of the rectal tube or the escape of any enema material.

The warmed room, the preliminary explanation of the procedure, the gentle handling of the patient with the instruction to lie comfortably are indeed all very minor points, but taken collectively should result in proper muscular relaxation, which is an absolute essential for satisfactory examination.

The Screening.

One assistant holding the can about thirty centimetres above the level of the patient and governing the clip stands by the examiner at the working side of the table and another, when all is ready for screening, stands on the opposite side holding the

fluorescent screen. If two assistants are not available the patient himself may assist in holding the screen. This leaves both hands free for tube box movements and palpation.

The screening commences by closing down the diaphragm to a small field and noticing the position of the rectal tube; if badly kinked slight withdrawal will straighten it. The assistant then releases the clip and the enema flow commences.

The rectum normally takes an appreciable time, a minute or two, to fill and it gradually distends before and while the sigmoid fills. Owing to this distension causing overshadowing, the region of the recto-sigmoid and distal sigmoid is most difficult to visualize. The procedure that keeps this rectal distension to a minimum, that is low pressure of enema administration, the container about thirty centimetres (twelve inches) above the level of the patient and aided by gravity is therefore advocated. The closest watch should be exercised upon the advancing flow and the screening should not be interrupted until the sigmoid shadow is free. Tube box movements upwards and laterally will often help to throw some of the loops clear of the large central recto-sigmoid shadow, but in many apparently normal persons the radiologist is convinced that all the sigmoid loops have not been satisfactorily inspected. For this reason I am of the opinion that the rectum and the distal end of the sigmoid are better investigated by the sigmoidoscope.

Fortunately, however, conditions are somewhat different when an obstructive lesion exists in this region, since the obstruction causes slower filling and the dilated and ballooned rectum throws the sigmoid upwards clear of the rectal shadow. In some patients the rectum and sigmoid appear as one continuous large tube and the difficulty of overshadowing is eliminated.

The sigmoid, becoming the iliac portion of the colon at the brim of the true pelvis, is often subjected to pressure at this bony ridge; this gives rise to a pressure filling defect which may be more or less constant, especially in emaciated subjects lying on the back. Deep palpation with repeated inspection and if necessary the prone position will decide the true nature of this defect. The sigmoid, iliac and descending colon which frequently present redundant loops, usually fill rapidly until the splenic flexure is reached where the altered course of the colon causes the onward flow to appear to be less rapid. Palpation, lateral tube box movements and rotation of the patient are often necessary to separate the distal half of the transverse colon from the descending colon. The transverse fills not quite so rapidly and transient defects are often seen due to pressure upon the spine. The regions of the hepatic flexure, the ascending colon and the caecum necessitate more effort and care in their filling than other parts of the bowel; filling is often slow, three loops of bowel are often lying adjacent to one another and the position of the caecum is very variable and unknown until it has been filled; the patient at this stage may be a trifle uneasy and one is tempted to hurry and bring the examination to a close. If the patient's anxiety is allayed and his muscles are kept relaxed, careful palpation with the flow, lateral tube box movements, rotation of the patient and a little patience will result in filling this proximal part of the colon and rendering it visible.

The filling of a few coils of terminal ileum which occurs to a minor extent in most persons is always welcomed with relief, as it gives the examiner an assurance that a caecal filling defect has not been overlooked.

If during the examination the onward flow of the contrast mixture ceases or is very slow, it is necessary to make sure that the tubing or rectal tube is not blocked and the whole length of the tubing should be "milked" to clear an obstruction if one should exist.

If complete arrest of the onward flow occurs and it is certain that the enema is being admitted under adequate pressure, an obstructive lesion must be assumed; but in the absence of a definite filling defect the following events, in part or in whole, should be awaited before such a diagnosis is made: distension and elongation of loops already filled, therefore discomfort and pain, a leakage of the enema along the tube or expulsion of the tube.

Save in the presence of partial or complete obstruction there is no need to fear non-retention of the enema in patients of ordinary intelligence who have been properly prepared.

When the screen examination is completed, the tubing is clipped, the table is restored to the horizontal and the shoulder rest removed. The patient again lies upon his side and the rectal tube is withdrawn into the bowl; the swab of cotton wool serves to wipe away a few drops of the material that may escape from the anus at this procedure. The tubing is now disconnected from the rectal tube and the former coiled and put into the can. The only soiled article is the bowl with the rectal tube and swab which can be immediately covered with antiseptic.

The absence of fæcal contamination gives confidence in examining these patients and avoids much cleaning and disinfectant.

The patient now transfers himself to the Potter-Bucky table and a 17 by 14 film is exposed under the following conditions:

The patient is in the prone position; the lower edge of the plate is in line with the gluteal fold. The current is 120 milliampères, the tube distance is seventy centimetres (twenty-eight inches); the exposure time is one to one and a half seconds. The voltage is according to size of patient. Double coated films and screens are used. Respiration is suspended.

This last factor is an important one and before exposure the patient is instructed and given practice until it is assured that movement can be eliminated.

If thought advisable, a second exposure is made after defæcation.

Fischer, of Frankfurt, has introduced a modification of this method. He employs both opaque material and air as injection media with the object

of coating the walls of the air distended bowel with a thin layer of the denser material. This would appear to be the ideal method of examination as it would portray to greater advantage the luminal contents.

Its practical application suggests many difficulties; I have had no experience with the method.

Diagnostic Signs.

The colon as imaged by its luminal shadow should be considered with regard to the following:—

1. Filling defects.
2. Deformities of contour.
3. Extra luminal shadows.
4. Haustral segmentation.
5. Rate of filling.
6. The size of the lumen.
7. Redundancy.
8. Mobility.
9. Distensibility and elasticity of the bowel wall.
10. Competency of the ileo-caecal valve.
11. Certain phases of functional activity.
12. The relationship to palpable masses.
13. General and local topography.

In reply to Dr. Praagst DR. F. MYERS (Wellington) stated that the height for the douche can in barium enemas should be one foot above the patient. Dr. Praagst emphasized the importance of keeping the douche can low on account of the too rapid filling of the colon.

DR. P. D. CAMERON (Wellington) stated that he used a hard vulcanite nozzle for irrigation. It did not have to be held in place and was of no discomfort to the patient. Dr. Stowe had noticed that reverse peristalsis was the trouble in many cases. In examination of the pelvic colon which was always a difficult matter, he believed that he could recognize the sigmoid sphincter which appeared as a valve with double cusps.

In reply to Dr. Guthrie Dr. Myers stated that in his experience an enema of one and three-quarter litres (three pints) was sufficient for any patient, although Dr. Guthrie had used as much as three and a half litres (six pints).

X RAY DIAGNOSIS OF DUODENAL LESION.

By H. R. SEAR, M.B. (Sydney),

Honorary Radiographer, Royal Prince Alfred Hospital, Sydney.

IN this short paper dealing with lesions of the duodenum an attempt has been made to link up briefly the clinical aspect with the röntgenological findings. No fresh method of examination is advocated, though stress may be laid on certain aspects of the latter during the course of the pamphlet.

The histories and X ray findings of the last five thousand odd patients who have been referred to me in private practice for X ray examination of the stomach and duodenum, I do not include those suffering from intestinal conditions, have been investigated with the results as tabled.

I have taken these cases for dissection and not hospital cases for the simple reason that there is some uniformity in the history taking in private practice which is quite lacking in the histories at hospital due to the constant change of resident medical officers.

Various objections have been raised to the taking of histories by the radiographer, that he may be biassed and so forth. I maintain that if a man has pride and faith in his work, this will not hold. Again it has been said that a radiographer in so doing wastes time that he might put to better use, especially financially, that the history should be referred to the radiographer by the clinician. Here again we have a lack of uniformity and in some cases a scanty and insufficient and even at times an inaccurate history.

I have always endeavoured to get as accurately as possible the earliest symptoms which in these cases are usually the most diagnostic.

TABLE I.—PATIENTS REFERRED WITH HISTORY OF GASTRIC DISORDERS.

(Not including those sent for examination with opaque enemata.)

Lesion Discovered.	Number of Patients.	Proportion, Male to Female.
Œsophageal lesions	46	2:1
No organic lesion in stomach or duodenum	2,920	
Gastric ulcer (away from pylorus)	158	1:1
Juxta-pyloric ulcer	171	2:1
Duodenal ulcer	549	9:2
Adhesions in duodenal region	203	
Cholelithiasis and cholecystitis	233	
Gastro-enterostomies	114	
Carcinoma of stomach	214	3:1
Rare lesions	69	
Appendiceal and intestinal lesions	654	
All lesions	5,331	

Table I reveals the incidence of duodenal ulcers. Of all the patients examined complaining of gastric discomfort, rather more than one in ten suffered from this condition.

Of these five thousand odd patients almost eleven hundred gave histories that suggested duodenal ulcer, yet in over six hundred no duodenal ulcer was detected.

TABLE II.—PATIENTS WITH HUNGER-PAIN APART FROM DUODENAL ULCERS.

Lesion Discovered.	Number of Patients.
Duodenal ulcer with hunger pain[1]	464
No organic lesion in stomach or duodenum[2]	466
Gastric ulcer[3]	29
Gastric carcinoma[4]	21
Gall bladder	20
Duodenal adhesions	46
Juxta-pyloric ulcer	46
All lesions	1,092

[1] The total number of patients with duodenal ulcer was 549.
[2] Some of the patients had a pathological condition of the appendix.
[3] The total number of patients with gastric ulcer was 158.
[4] The total number of patients with gastric carcinoma was 214.

Hunger-pain was also present in some of the rarer lesions, for example in some patients with pancreatic lesions.

Table II reveals that of the total number of patients with hunger-pain (1092) duodenal ulcer was accountable for the symptom in only 464.

(To be continued.)

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